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ARTICLE V.

ON THE GLOSSOPHAGINÆ

(Plates VI-XV.)

BY HARRISON ALLEN, M.D.

Read before the American Philosophical Society, January 21, 1898.

Having an impression that the genera of bats are best defined by minute characters in the skull, teeth and wing membranes, I am led to review the Glossophaginæ—a sub-family of the Phyllostomidæ, concerning which unsatisfactory accounts exist both as to structure and relationship.

The bats embraced in the group are characterized by a slender protrusile tongue, an elongated jaw and a deeply cleft lower lip.* The temporal impression is faintly marked and the sagitta is absent or confined to the frontal bone. The thumb and forearm are long. The olecranon lies on the upper side of the wing membrane. The canine teeth are long and the upper molars without hypocone. The incisors are so diminutive as to permit the tongue to be freely projected without wide separation of the jaws.

According to P. Osborne (*Proc. Zool. Soc.*, 1865, 82) the thumb aids in the seizure of small fruits, the teeth tear through the skin and the long tongue extracts the semi-fluid contents. As in the Edentata, the elongation of the jaws and tongue has led to the simplification of the teeth. But reduction in number of the teeth has gone on scarcely at all; indeed, the most highly specialized forms are those having the largest number of teeth.

The genera are arranged in three alliances—the glossophagine, the choeronycterine and the phyllonycterine. The first is composed of *Glossophaga*, *Leptonycteris* and probably *Monophyllus*; they certainly relate closely to the Vampyri. The second of the highly specialized and more doubtfully placed group of *Choeronycteris*, *Lonchoglossa* and *Anura*,

* Zoölogists are indebted to Prof. W. Peters (*M. B. Akad.*, Berlin, 1868), for a revision of the group of the glossophagine bats. The diagnoses are unfortunately sometimes inadequate and without critical analyses of synonymy. The confusion arising from the circumstance last named is to be acknowledged; as a result, the task of identification when not aided by inspection of type specimens is difficult. Dobson in his well-known catalogue of the Chiroptera in the British Museum, 1878, follows Peters closely—often indeed merely translating or paraphrasing his language—and on the whole shows less acumen than characterizes his admirable work elsewhere.

is probably also of Vampyrine origin. The third division contains but a single genus, viz., *Phyllonycteris*. It is so near *Brachyphylla* that it would be easy to effect the transition and remove the genus to the alliance expressed by the term brachyphylline. It is akin, therefore, if not annectant, to the subfamily Stenoderminæ.*

The material available for the study just completed was not large, and two genera, namely, *Monophyllus* and *Glossonycteris*, I have not seen. I have concluded from the published descriptions of *Glossonycteris* that doubts can be frankly expressed concerning the validity of this genus. Perhaps not enough stress has been laid upon the effects of age in attempting to separate it from *Anura*.

Reliable characters are found in the lower molars. The extension forward of the ridge (anterior commissure) between the protoconid and the paraconid is more marked than in any other group, and is in consonance with the compression of the crowns. The ridge is not spinose, and is scarcely raised. In *Glossophaga* the ridge is constantly as in the Vampyri, but in the other genera it is an extension forward from the protoconid. No trace of hypocone is seen in the upper molars.

The row of glands lying to the outer side of the nostril is discernible in all genera except *Phyllonycteris*. Minute distinctions are found in the degree of development of these glands. They are best developed in the glossophagine group, and least so in the chœrnycterine. In *Phyllonycteris* the ecto-nareal gland-row is occupied by a flattened fold of skin which becomes incorporated with the nose leaf.†

The proportions of the width of the third and fourth digital interspaces taken at the distal ends of the metacarpal bones when the wing is extended is found to be as valuable an aid in determining affinities as elsewhere in the order. In like manner the shapes of the terminal cartilages of the fourth and fifth digits, the arrangements of muscles and nerve markings of the wing membrane are noted as furnishing excellent characters.

The following scheme of interdigital diameters is given :

	Second Interspace.	Third Interspace.	Fourth Interspace.		Second Interspace.	Third Interspace.	Fourth Interspace.
<i>Glossophaga soricina</i>	2	12	17	<i>Lonchoglossa</i>	2	16	23
<i>Glossophaga truei</i>	2	11	15	<i>Anura</i>	3	15	30
<i>Leptonycteris</i>	3	15	25	<i>Phyllonycteris</i>	3	13	25
<i>Chœronycteris</i>	2	11	20				

Enough can be gleaned in the way of inductions from the shapes of the anterior

* In a paper by myself, entitled "On *Ametrida minor*" (*Proc. Bost. N. Hist. Soc.*, 1892), I used inadvertently the term *Stenodermatidæ* for this subfamily.

† The genera of the remote megaderminine genera are in like manner distinguished by characters in rows of glands as contrasted to folds of skin, though the structures are here not ectonareal, but infranareal. In *Megaderma* the glands are distinct, while in *Lyroderma* and *Lavia* they are supplanted by a skin-fold which becomes an integral part of the nose leaf.

extremities and the details in the phalanges and terminal cartilages to warrant the introduction at this place of a few remarks on the subject of flight.

Leptonycteris. The greatest restriction in the movements of the digits is found in *Leptonycteris*. The sharp flexure of the second row of the phalanges on the first impede rapidity of flight, while the axially disposed, terete terminal cartilages show absence of strain. The second and third metacarpals always maintain an acute angle to the forearm.

Glossophaga and *Chaeronycteris*. These genera resemble *Leptonycteris*, differing therefrom in degree only in the greater degree of interphalangeal flexure and in the angulation of the second and third digits to the forearm.

Anura shows scarcely any tendency to flexure or angulation of the parts above named while the terminal cartilages of the third and fourth digits are markedly deviated from the axial positions and thus appear to correlate with increase of wing strain.

Lonchoglossa is intermediate between *Anura* and the preceding group.

Phyllonycteris shows an isolated position from the foregoing group as a whole, on account of the terminal cartilage of the fifth digit being entirely embraced by the wing membrane. It is a curious circumstance that the remote *Leptonycteris* exhibits a similar peculiarity.

It cannot escape notice in studying the group that the extraction of soft pulp from a fruit is not unlike the lapping of blood. Acquirements apparently so diverse as fruit-eating and blood-taking are not so improbable as they might appear to be at first sight. Geoffroy, who established *Glossophaga*, yet who had no knowledge of the habits of the species, concluded from the structure of the tongue that the animal was a blood-sucker.* In adapting the head so as to create a blood-lapping from a pulp-extracting form the greatly elongated jaws are shortened, the face flattened, and the teeth become knife-like. In this manner we may trace the transitions which have taken place in the Vampyri in creating on one hand the *Glossophaginæ* and on the other hand the *Desmodinæ*.

In *Glossophaga* the *Flexor carpi radialis* passes along the upper border of the radius as far as the distal third, at which point it crosses the curved radius to reach the carpus. In *Chaeronycteris* and *Lonchoglossa* the tendon of this muscle lies to the lower border of the nearly straight radius.

The *Flexor sublimis digitorum* has the weakest development in *Chaeronycteris*, in which form it supplies the first and fourth digits only. In *Phyllonycteris* it omits only the second, while in *Lonchoglossa* and *Glossophaga* it supplies all the digits.

* The stomach in the *Glossophaga villosa* Rengger (*Naturgesch. der Säugethiere von Paraguay*, Basel, 1830, 80) was found to contain blood with remains of insects. It is not known what forms would now be included under this title. See remarks on *Anura*.*

The origin of the *Glossophaginæ* is easily traceable to the group denominated by Peters the Vampyri. But the division between the genera composing the Vampyri is of a character to suggest two groupings at least, and the term Vampyri is best used in a restricted sense. Indeed, it is a small cluster of four genera only (*Vampyrus*, *Macrotus*, *Schizostoma* and the aberrant *Hemiderma*), which possess a large, triangular, first upper premolar and an inflated, weak periotic region.

Of the second group (Phyllostomi), of which *Phyllostoma* is the type, I have imperfect knowledge—having studied besides this form the genera *Lonchorhina* and *Lophostoma*. But they agree in having the first upper premolar small and acicular, a peculiarity I find figured in Gervais (*Exp. du Sud.*) as characteristic of *Tylostoma* and *Monophyllum* (*Dolichophyllum*). I infer that *Trachyops*, *Phylloderma* and *Mimon* are members of this group from Dobson's statement (*Br. Cat. Chir.*) that they resemble *Phyllostoma*. I have no satisfactory knowledge of the periotic region in this group, but can say that it is boldly defined, concave, and not inflated in *Phyllostoma*, *Lonchorhina* and *Lophostoma*.

Now it has been seen that the *Glossophaginæ* yield two groups—that of the Glossophagi and that of the Lonchoglossi. In my judgment these do not have a common origin. The Glossophagi agree with the Vampyri as above restricted in the shape of the first upper premolar and the inflated periotic region, while the Lonchoglossi are much nearer the Phyllostomi. *Chaenycteris* possesses a triangular premolar (with large denticles) and a moderately truncate concave periotic region, but its other characters, taken as a whole, connect the form intimately with the Glossophagi.

The taxonomic value of the terminal cartilage can be determined only by the examination of extended series. At first I had inferred that the shapes of the cartilages of the fourth and fifth digits were of considerable value. But inspection of the largest number of individuals of the most common species—namely, *Glossophaga soricina*—gave me an impression that they were really variable structures; thus in one individual from Costa Rica they were both spatulate; in another from Bahama Islands they were both aciculate; and yet in a third specimen from the last-named locality the fourth digit was spatulate and the fifth aciculate. Nevertheless the variability itself is of interest and I have, therefore, figured the cartilages, believing that after extended observation they may assist in more firmly defining the minor groups of species than is now the case.

GLOSSOPHAGA.

Upper incisors in a continuous row. Length of forearm not exceeding 36 mm.; thumb, 8 mm.; calcar present; the tail is short with free tip on the dorsum of the interfemoral membrane. Proencephalon creates an eminence on brain case; fronto-maxillary inflation conspicuous; mastoid process small.

Dental formula: i. $\frac{1}{4}$ — c. $\frac{1}{1}$ — pm. $\frac{2}{3}$ — m. $\frac{3}{3}$ = 21.

The *Flexor profundus digitorum* supplies second and third digits only. The *Semimembranosus* and *Biceps femoris* are absent. The tendons of the *Gracilis* and *Semitendinosus* closely approximate and give the appearance of being fused, but by gentle traction they can be shown to be distinct.

Pallas first described *Glossophaga soricina* as having no tail (*Misc. Zoölog.*, 1766, 48), the type being a female. He subsequently described and measured a second specimen (*Spicil. Zoöl.*, III, 1767, 24), a male, which he dissected. He now noted the presence of a short tail and figured the skeleton in which the tail is plainly seen. Geoffroy accepted the first description as final, and proposed a separate name (*G. amplexicaudata*) for the assumed new species possessing a tail. Gray (*Ann. and Mag.*, N. S., 1838, II, 490) acting on these erroneous premises proposed the name *Phyllophora* for *Glossophaga amplexicaudata*. Gervais (*Expn. Amerique du Sud.*, 1855, II, mem., 40) sustains Gray's position without comment. Peters set the matter to rights in 1868, over a hundred years after Pallas' first simple error of observation.

Of the elaborate measurements of Pallas those taken of the male are the most accurate and include those of the skeleton as well. The figure of the head by Geoffroy also conforms in vertical measurement. The width of the basal part of the nose leaf is less than in our figure. Pallas, Geoffroy and Spix all accurately figure the interfemoral membrane as approaching the ankle, certainly reaching a point below the level of the middle of the tibia, which is the distance given by Dobson.

The fact that the two forms of *Glossophaga* differ so widely makes it desirable that the characters of the first recorded species be carefully noted. A review of the original description of Pallas is of restricted value, other than the anatomy of the soft parts, notwithstanding the praise Geoffroy and Dobson award it. Geoffroy states he had dissected an alcoholic specimen and confirmed Pallas' observations. But Pallas did not note so conspicuous a fact that in the first digit the metacarpal bone is much shorter than the combined lengths of the phalanges. The cranial and dental outlines are worthless;* but one cannot gainsay the value of the figure of the fimbriated and elongated tongue.

Synoptical Table of Genera.

1. <i>Glossophaga vera</i> .	{ Palatal portion of premaxilla forming a rostrum in advance of median incisive foramen; gland mass confined to sides of nose leaf; occipito-squamosal suture without foramen; tympanic bulla separated from postglenoid process by a conspicuous interval; ethmoid bone convex in brain case; no ectopterygoid lamina; in third to fifth digits first phalanx smaller than second; fimbriæ not confined to tip, but extending well back along the tongue.
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* Gervais (*l. c.*) believes the form is not *Glossophaga* at all, but *Hemiderma*.

- a. Median upper incisors larger than lateral; premolars $\frac{2}{3}$; crown of lower canine with base lying inside position of lateral incisor; median incisor foramen barely in advance of paired foramina; upper incisors inclined; pit over proximal third of face vertex.
- b. Upper incisors in continuous row; molars $\frac{3}{4}$; thumb one-fourth the length of forearm (31-34 mm.).....*Glossophaga*.
- b. Upper incisors with wide interval between centrals; molars $\frac{3}{4}$; thumb one-sixth the length of forearm (45 mm.).....*Leptonycteris*.
- a'. Median upper incisors smaller than lateral; premolars $\frac{3}{4}$; crown of lower canine with base not lying inside position of lateral incisor; median incisor foramen well in advance of paired foramina; upper incisors vertical.
- c. Lower canine compressed, with cingulum; metacarpal bone of thumb exceeds length of phalanges.
- d. No phalanx to second digit of manus; premolars $\frac{3}{4}$; tail present; thumb one-seventh the length of forearm (42 mm.).....*Chaeronycteris*.
- c'. Lower canine rotund, no cingulum; metacarpal of thumb equal length of phalanges.
- d'. Phalanx to second digit of manus; tail present; thumb one-eighth the length of forearm (38 mm.).....*Lonchoglossa*.
- d''. No phalanx to second digit of manus; no tail; thumb one-sixth the length of forearm.....*Anura*.

II.

Glossophagina aberrantia.

{ Palatal portion of premaxilla not rostrum-like; gland mass crosses muzzle back of nose leaf; tympanic bulla almost touches postglenoid process; occipito-squamosal suture with large foramen; ethmoid bone not convex in brain case; an ectopterygoid lamina. In third to fifth manal digits first and second phalanges equal; premolars $\frac{2}{3}$; molars $\frac{3}{4}$; fibræ of tongue at tip only.

Tail present; exceeding short interfemoral membrane; thumb one-fourth the length of forearm (45 mm.)..*Phyllonycteris*.

Glossophaga soricina Pallas.

Auricle emarginate at upper half of the outer border; internal basal lobe free from head and indications of basal ridge. Lappet in side of the external basal lobe stout, pointed. Wing membrane from ankle. Terminal cartilage, fourth digit spatulate. Rudiment of an ascending process from the zygoma.

Auricle subrounded, internal basal lobe with suggestion of vertical ridge, outer margin of auricle sinuate; external basal lobe large, obtuse, retroverted, internal lappet a mere projecting nodule. Tragus straight on inner, convex or obscurely serrate on outer, margin. The nose leaf hairy and small, midrib confined to the pedicle. The leaf proper projecting nearly one-half its length above the conspicuous gland mass. The upper lip as well as the borders of the groove in the upper lip furnished with four to nine minute warts. Above, the fur is dark, sooty gray, at the tip the remainder of the hair being lighter but nowhere white. Beneath paler, unicolorous. Interfemoral membrane almost

as long as tibia. The calcar is one-half the length of the tibia. The interfemoral membrane is often incised rather than semicircular.* The tip of the tail projects from the free margin of the interfemoral membrane. Tongue on dorsum free from retrose papillæ.

The first phalanx of the first digit is as long as the metacarpal. Entire digit one-fourth or nearly one-fourth the length of the forearm (10 to 40, or 8 to 36). The first phalanx of the second digit is one-thirtieth the length of the metacarpal; the entire digit is not as long as the third metacarpal. The first phalanx of the third digit is smaller than the second; the third is flexible; the separation from cartilage tip is indeterminate. Metatarsi equal. The row of first phalanges of toes equal.

The Skull.—The brain case papyraceous; the position of the body and hemispheres of the cerebellum—the mesencephalon and prosencephalon—being clearly outlined on the periphery. Pretemporal crests scarcely defined and not continuous with the orbital margin; mesotemporal not seen; posttemporal not distinct from the occipital.

The face vertex is flat with shallow median depression over the ethmoid bone. The convex nasal bones are outlined by grooves, of which the median is the widest and deepest. Each nasal bone is incised on its free margin at the anterior nasal aperture. The sides of the face are convex, with a conspicuous, though small fronto-maxillary inflation. The infraorbital foramen answers in position to the junction of the premolars. The lateral border of the anterior nasal aperture is produced; between it and the prominence over the canine tooth a groove is defined. The height of the alveolus is one-third the width of the neck of the canine, and one-seventh the vertical diameter of the anterior nasal aperture. The posterior border of the hard palate near the zygomatic root is spinose. The palatal notch at the mesopterygoid fossa is acutely incised, carried back to a line answering to the glenoid notch and is without median spine. It reaches a point opposite the posterior third of the zygomatic arch. The tip of the pterygoid process lies opposite the oval foramen. The ascending process of the zygoma is inconspicuous and rounded. Base of cranium with prominent, median, vomerine ridge. The lateral depressions on the basioccipital are conspicuous, the mastoid process is obtuse. The tympanic bone is separated from the postglenoid process by an interval. The coronoid process of the lower jaw is carried above the level of the condyle and is subacuminate. The angle is hamular and deflected outward with a notch between it and the lower border of the masseteric impression and projects backwards slightly beyond the condyloid process. Symphysis not carinate. The junction of the ethmoid and sphenoid bones in brain case convex.

The Teeth.—The teeth of *Glossophaga* are the best defined of any of the group. The cusps are sharp, the incisors and premolars are adapted for cutting, and the molars

* Geoffroy expressed it thus, “coupée en angle rentrant,” but this shape is often absent.

for grinding. In the upper jaw, with the exception of an interval on either side of the canine, all the teeth are contiguous.* In the lower jaw there is no interval on either side of the canine, for the lateral incisor and the first premolar are in contact with it. The upper incisors are arranged in a small arc, which is smaller than the space between the canines.

The central incisor is hatchet-shaped, the outer margin concave. The lateral incisor is smaller than central, with inner border twice the length of the outer. The canine is concave on the palatal surface. The premolars are triangular subequal, yet the heel of the second tooth is twice the size of the first. The cingules are scarcely discernible. The first molar is subtriangular with W-shaped crown reduced, the fluting on the paraconid, rudimental; the metacone is united to protocone by a ridge. The second molar is subquadrate, W-pattern scarcely reduced; the fluting on the paracone marked; the ridge from the metacone not reaching the protocone, but a distinct though narrow valley intervening. The third molar is one-half the size of the second, the second V being rudimental. The longitudinal axis of both second and third molar is oblique to axis of the alveolar processes. The third molar slightly overlaps the second at the buccal border.

The lower incisors are provided with flat smooth edges to the crowns and are adapted to crushing rather than to cutting food. The canine is directed slightly backward and is provided with a small heel. The premolars are triangular, equal, the bases increasing in thickness from before backward. The molars exhibit marked commissural extension in advance of protoconid and paraconid. The hypoconid is cuspidate and as high as metaconid; all the teeth are much alike, but become progressively smaller and narrower from the first to the third, while the extension in front of the paraconid and protoconid become less and less marked. The third tooth is not more than two-thirds the length of the first.

In a skull of an embryo which measured 8mm. long, the lower jaw projected well in front of the upper and bore the deciduous canines. The shapes of the incisors and premolars could be discerned, while the upper jaw was edentulous.

In an adult which retained the right upper lateral incisor only and the molars were much worn, the only teeth in the upper jaw that were in contact were the second and third molars. In the lower jaw the third molar was separated from the tooth both the first and third. The lower incisors were much worn and placed slightly in advance of the lateral teeth. I am inclined to believe these are variations due to advanced age.

* The upper incisors as represented by Leche (*Studier öfver Mjolkdentitionen och Tändernas Homologier hos Chiroptera*, 1876, Tab. II, VII) do not touch.

Glossophaga truei, n. s.

In the *Proc. U. S. Nat. Mus.*, XVIII, No. 1100, 1896, 779, I described a new species of *Glossophaga* under the name *G. villosa*. Since Rengger (*l. c.*, p. 80) described in 1830 a species under this name I have concluded to rename the form, notwithstanding that the species is quite different from the genus *Glossophaga* as now restricted. See remarks under *Anura*. I take pleasure in dedicating this species to the accomplished Curator of Mammals of the National Museum, Mr. F. W. True. I herewith reproduce the description, which now has the advantage of appearing with appropriate figures of the head, skull and teeth.

It is a remarkable circumstance that the genus *Glossophaga*, while the most common of any of the forms embraced in the group of Glossophagi, and has been collected from the widest range of any of its race, should have presented degrees of variations so low as never to have permitted the recognition of more than a single species. The complicated synonymy successfully unraveled by Peters, it is true, contains a number of names of species, but these were proposed through misapprehension of assumed generic values and bear no relation to questions of specific distinction.

A careful study of two specimens (Nos. 9522 and 9523) belonging to the United States National Museum has convinced me of the necessity of recognizing two species of *Glossophaga*—namely, *Glossophaga soricina* and the one which I here name

Glossophaga truei.

Auricle entire on outer border or slightly emarginate. Internal basal lobe bound down to head without trace of ridge. Excepting in length of head and trunk everywhere smaller than *G. soricina*. The ascending process of the zygoma twice the size of the same part in that species. Wing membrane from distal fourth of tibia. The terminal cartilage of the fourth digit terete.

The auricle is without ridge at base of the internal basal lobe, which is scarcely defined and closely bound down to head; outer margin almost entire; external basal lobe and nodule inconspicuous. Tragus with trace of serration on outer margin, basal lobe large, quadrate.

The nose leaf, hairy, without midrib at internarial pedicle, projecting scarcely at all above the simple gland mass of the upper lip, which it almost entirely occupies. Thumb one-fourth the length of the forearm—namely, nine to thirty-two. The tail had evidently occupied a position similar to that seen in *G. soricina*. It had been removed in preparing the skin.

Based on skins of two adults : No. 9523, U. S. N. M., La Guayra, Venezuela ;* and No. 9522, U. S. N. M., co-types.

No. 9523, U. S. N. M., fur soft, shrew-like ; dull ash at basal two-thirds, sooty at apical third ; it extends along the entire length of the dorsifacial region. No. 9522, U. S. N. M., quite the same, but is dark brown instead of sooty.

The skull † closely resembles that of *G. soricina*, but is smaller and thinner walled. The ascending process of the zygoma is longer and more pointed than in the species just named ; the palatal notch is less acute. The fronto-maxillary inflation is conspicuous. The symphysis menti is carinate. The angle of the lower jaw projects backward slightly beyond the line of the condyloid process. The brain case is 12 mm. and the face 7 mm. long.

The upper central incisors broad with slightly concave cutting edges ; the lateral incisors are narrow with oblique cutting edges. The premolars are slightly separated from one another and the second premolar from the first molar ; they are compressed, subequal, and triangular ; the second premolar is thickened posteriorly. The other teeth closely resemble those of *G. soricina*. The first upper molar is longer than the second and the second longer than the third ; there are no ridges extending from the paracone to the metacone. The third upper molar does not overlap the second molar at the buccal border.

The muscle fascicles and nerve markings of the endopatagium disposed as in *G. soricina*. This system is the weakest of any of the group of the Glossophagi. The terminal cartilages are throughout terete.

On the whole the descriptions of Pallas and of Geoffroy agree well with *Glossophaga soricina* of Peters' revision, and exclude those specimens here embraced under *G. truei*. In Geoffroy's figure ‡ the measurements of the nose leaf agree with those of *G. soricina*, but the shape of the tragus and internal basal lobe of the auricle are like those of the form under consideration. But the figure is evidently based upon a dried specimen.

The isolation of the premolars in *G. truei* answer fairly well to the arrangement of the teeth in an old example of *G. soricina*. This is an interesting fact, inasmuch as it suggests that senile characters in one species may be the same as those found in young adult life of another.

The following proportions are noteworthy : The first phalanx of the third digit is longer than the second. The third metacarpal bone is as long as the forearm. The

* It is not certain that the locality here given is the correct one. The record in the National Museum catalogue is imperfect.

† In addition to the skull in the type specimens, I possess a skull from Brazil presented by the late Mr. Harte, which answers to the above description.

‡ *Ann. du Mus.*, 1810, XV, Pl. XI.

forearm is 1.15 mm., the smallest in the group. The calcar is one-third the length of the tibia. The first phalanx of the first toe extends slightly beyond the first phalangeal joint of the second toe. The first row of phalanges decreases progressively from the second to the fifth toe.

Type.—No. 9522, U. S. N. M.*

Measurements of Glossophaga truei.

	Millimeters.
Head and body (from crown of head to base of tail)	45
Head and forearm.....	32
First digit :	
Length of first metacarpal bone.....	4
Length of first phalanx.....	4
Second digit :	
Length of second metacarpal bone.....	25
Length of first phalanx	2
Third digit :	
Length of third metacarpal bone.....	30
Length of first phalanx.....	11
Length of second phalanx.....	14
Length of third phalanx	6
Fourth digit :	
Length of fourth metacarpal bone.....	27
Length of first phalanx	9
Length of second phalanx	9
Fifth digit :	
Length of fifth metacarpal bone.....	27
Length of first phalanx	8
Length of second phalanx.....	8
Length of head.....	21
Height of ear.....	11
Height of tragus	3
Length of tibia.....	11
Length of foot	8
Length of interfemoral membrane.....	9

MONOPHYLLUS.

Upper incisors not in a continuous row. The first and second upper molars with hypcone. Length of forearm, 37 mm.; length of thumb, 10 mm. The tail projects from the margin of the short interfemoral membrane. The proencephalon does not create an eminence on the brain case. No vertical line is found on any of the interdigital spaces.

Dental formula : i. $\frac{4}{4}$ — c. $\frac{1}{1}$ — prm. $\frac{2}{2}$ — m. $\frac{3}{3}$ = 21.

* The measurements of No. 9523, U. S. N. M., are the same as in No. 9522, U. S. N. M., excepting in the second phalanx of the third manal digit, which is but 12mm. long.

The single specimen of *Monophyllus* which was available was that of a skin of an adult (No. 83347, ♀, U. S. N. M.) obtained by exchange from the Berlin Museum. The genus is in close alliance with *Glossophaga*—closer, indeed, than any two genera of the group. The retention of the hypocone in the first and second upper molars, the presence of a keel on the symphysis of the lower jaw and absence of the vertical line in the interdental spaces, separate the two forms. Other characters if they existed unassisted by those just named would be those of relation and proportion. The presence or absence of the calcar could not be determined.

Monophyllus redmani Leach.

Auricle with blunt tip, scarcely emarginate on outer border. Wing membrane from basal third of the tibia: terminal cartilage of the fourth digit, spatulate. Marked rudiment of ascending process from the zygoma. Nose leaf, upper lip and membrane much as in Glossophaga truei.

The auricle resembles *G. truei* nearer than *G. soricina*. It is blunt at tip, scarcely at all concave on the outer margin. A faint emargination is noted on the inner margin which may be exaggerated in the dried skin. The external basal lobe was everted by the method used in preparing the specimen. The parts do not differ from those studied in *Glossophaga*. The tragus is blunt, presenting two coarse sinuations at the outer side and two denticulations at the base. The nose leaf, upper lip and mentum almost precisely the same as in *G. truei*. No warts are anywhere present.

Fur above is dark brown; the head, neck and shoulders a lighter shade than the back of thorax and loin. Examined with a lens, the fur has an admixture of fine gray hairs, which are more numerous on head, neck and shoulders than elsewhere. The fur beneath is gray and brown, about equally admixed. Both above and below the hair is unicolored. Sparse gray hairs extend below on arm to elbow and slightly over the endopatagium. The legs are naked.

There is no vertical line on the membrane of any of the interdental spaces. The endopatagium exhibits a few coarse vertical lines. The fourth interdental space is obscurely areolate.

The skull was mutilated at occiput and posterior third of the base. It closely resembles *Glossophaga*. The fronto-temporal crest is more defined, while the fronto-maxillary inflation is less defined than in that genus. The posterior palatine notch, narrow. Seen from above, the posterior border of the infraorbital foramen appears as a blunt spine. A narrow but well-defined groove extends the entire length of the face, beginning at a foramen near the pretemporal ridge. The ascending process from the zygoma is greatly in excess of the same character in *Glossophaga*. The external auditory opening

is smaller than in the genus just named. The thick skull does not admit of the divisions of the brain being discerned. The lower jaw is more robust—the depression in advance of the angle most marked of any genus in the group; the angle is raised high above the level of the lower border of the high ramus as in the *Lobostomina*; the symphysis is provided with a large keel.

On the whole the skull is more robust in texture and is of a larger animal than *Glossophaga*, but the face structures more extended, and presumably from the symphysal modifications, a longer and more prehensile tongue.

The Upper Teeth.—The incisors are not arranged in a continuous row or in pairs, but intervals* are found between the teeth.

The space between the central incisors is wider than that between these teeth and the laterals. The central incisors are obscurely hatchet-shaped, while the laterals are conical. Wide intervals also exist between the canine and the first premolar and between the first and second premolars. The other upper teeth are contiguous. The premolars are aciculate, compressed, with prominent base conules. The first and second molars are quadrate with conspicuous hypocone. The third molar is more triangular and resembles the first and second molars of *Glossophaga*.

The Lower Teeth.—The incisors are reduced to tubercles, arranged in pairs, which are widely separated both from the symphysis and the canine tooth, though nearer the latter than the former. The central incisor is larger than the lateral. All the other teeth are contiguous, except the second and third premolars, which are separated by an interval equaling that in the upper series. The first premolar is distinctive. It closely resembles the homologous tooth in *Glossophaga* and anteriorly overlies the base of the canine. The second and third premolars are similar to those in the upper jaw. The molars are of the same type as in *Glossophaga*, but elongated and compressed in advance of the protocone and paracone as in *Leptoncycteris*.

The comparison of the skull and lower jaw seen from in front with *Glossophaga* is instructive in the differences in the shapes and relations of the shapes of the teeth already noted. The upper canines are observed to be longer and more trenchant in *Monophyllus* than in *Glossophaga*.

Rugæ ten in number, the anterior five undivided and the posterior five divided.

Measurements of Monophyllus redmani.

	Millimeters.
Head and body (from crown of head to base of tail).....	24
Length of arm.....	0
Length of forearm.....	37

*According to Dobson's text, the upper incisors are in a continuous row, but they are figured with an interval between the central incisors. In the table of genera all the upper incisors are said to be arranged in pairs.

First digit :	Millimeters.
Length of first metacarpal bone.....	4
Length of first phalanx.....	6
Second digit:	
Length of second metacarpal bone.....	34
Length of first phalanx.....	2
Third digit:	
Length of third metacarpal bone.....	38
Length of first phalanx.....	13
Length of second phalanx.....	19
Length of third phalanx.....	9
Fourth digit:	
Length of fourth metacarpal bone.....	35
Length of first phalanx.....	8
Length of second phalanx.....	12
Fifth digit:	
Length of fifth metacarpal bone.....	30
Length of first phalanx.....	9
Length of second phalanx.....	10
Length of head.....	25
Height of ear.....	10
Height of tragus.....	3
Length of thigh.....	11
Length of tibia.....	15
Length of foot.....	11
Length of interfemoral membrane.....	4
Length of tail.....	5

LEPTONYCTERIS.

Upper central incisors separated by wide interval. Proencephalon not forming an eminence on the brain case. No spine at upper margin of the anterior nasal aperture caused by union of the free margins of the nasal bones. Tail none. Second phalanges of third, fourth and fifth digits sharply flexed on the first.

Dental formula : i. $\frac{4}{4}$ — c. $\frac{1}{1}$ — prm. $\frac{2}{2}$ — m. $\frac{2}{2}$ = 18.

Leptonycteris nivalis Saussure.

Auricle small, nearly one-half the length of the face, slightly emarginate at basal half outer border. Internal basal lobe scarcely free; external basal lobe convex, inner lappet crescentic. Tragus straight on inner, convex on outer side; basal lobe conspicuous. Nose leaf projects far beyond non-ribbed pedicle. The latter forms a wart-like contour inferiorly. The upper lip is narrow and provided with two inconspicuous nodules. Cartilages at the end of digits are as in Glossophaga. Calcar rudimental, scarcely one-fifth the length of the tibia.

Tongue furnished on sides and dorsum with minute, hair-like papillæ. The side of

the mental groove furnished with an obscure row of minute warts and the chin beyond the groove thickened with gland clumps.

Fur short, villose, longer on neck, above deep ash verging to gray, base white, below paler. On neck, basal part tawny, but abdomen almost unicolored. The hair is slightly whiter at pubis. Distal half of humerus (above and below) hairy—the rest of the limbs, except the base of thumb, second digit and all of dorsum of foot, covered with a sparse growth of short hair.

The muscle fascicles on wing membrane are much the same as in *Phyllonycteris*. They are wide apart generally, but do not extend over so large a field. The reticulated arrangement of fibres near the forearm is conspicuous. The longitudinal lines in the third and fourth interspaces distinct. The nerve markings are characteristic. Both arise from the digits far above the joint, the anterior being at distal third of the fourth metacarpal bones.

The terminal cartilage of the fourth digit scarcely spatulate; that of the fifth digit is terete and not free. In this respect *Leptonycteris* resembles the remote *Phyllonycteris*. The skin in the second interspace is not pigmented.

The Skull.—Skull not papyraceous; proscencephalon not defined. The pretemporal crests subtrenchant and form a short, faint conjoined line with its fellow at the sagitta; the scarcely discernible mesotemporal depressed, not reaching sagitta; posttemporal reaching occipital crest. Face vertex with depression over ethmoid, but the nasal bones are scarcely defined in median line and not separated at all laterally from the concave sides of the face. Fronto-maxillary inflation barely discernible and crossed by the orbital ridge. Alveolar process in height equals one-seventh the width of the neck of the upper canine and one-twenty-second the vertical diameter of the anterior nasal aperture. The depression between the lateral margin of the anterior nasal aperture and the root of the canine tooth much deeper than in *Glossophaga soricina*. Ascending process of zygoma rudimentary. The premaxilla weak in advance of the large incisive foramina; posterior border near the zygoma root not spinose. The rounded notch at the mesopterygoid fossa midway between zygoma root and glenoid cavity. Scarcely any difference observed between the level of the basioccipital and the basisphenoid. The mastoid process acuminate. The tip of the pterygoid process in advance of the oval foramen. The nasals are incised at the anterior nasal aperture. The angle of the lower jaw acute, not hamular; it is on the same plane with the masseteric impression, not separated therefrom inferiorly by a notch, and projects backward beyond the condyloid process. Symphysis not carinate. The lower border of the masseteric impression carried in a semi-circular line beyond the horizontal ramus.

The Teeth.—Teeth crowded for the most part. Upper incisors as in *Glossophaga soricina*; the central hatchet-shaped, separated by an interval. The lateral incisors as

large or larger than centrals. Canine concave on palatal surface. The first premolar without basal cusp and separated from the canine and the second premolar. The second premolar with basal cusp and in contact with the first premolar. The first molar much larger than the second, the paracone subtriangular, the outer surface of the paracone and mesacone are scarcely at all fluted, hence the W-pattern not evident. The second molar without fluting on the rudimental mesocone, hence the posterior limb of the second V is absent.

The single lower incisor which is seen in the two examples lies in close contact with the canine. The canines are large and divergent, projecting to the inner side of the lateral incisor. The three premolars are triangular with conspicuous cingules; lingual aspect of the first premolar concave and in contact with the canine; the second free from the first and the third premolar. The protoconid with a long anterior extension which has the value of a second functionalized cusp. The paraconid is small and placed slightly back of the protoconid. The mesoconid is higher than either of the other elements, and together with the hypoconid form a low, broad heel. Molars slightly overlapping at buccal borders; the metaconid and hypoconid are of great size with wide valley.

Metatarsi equal; first row of phalanges decrease progressively from the second to the fifth.

The measurements of Dobson do not agree in some respects with the three specimens examined. The thumb is smaller, while the first phalanx of the third finger is much larger. He states the "tail none or exceedingly short."

In the chœrnycterine alliance the genera *Chœrnycteris*, *Lonchoglossa* and *Anura* are placed. They have in common three premolars and three molars in each jaw.*

CHÆRNYCTERIS.

Naked skin fold defining nostril laterally. Pterygoid process in contact with tympanic bone. No phalanx to second digit. Length of forearm, 42 mm.; thumb, 7 mm.

Dental formula: $i. \frac{4}{4} - c. \frac{1}{1} - prm. \frac{3}{3} - m. \frac{3}{3} = 22$.

Chœrnycteris mexicana Tschudi.

Auricle subelliptical, emarginate on posterior border; internal basal lobe large, entirely free from the head and hairy; external basal lobe small, acute; internal lappet conspicuous. Tragus elliptical; basal lobe simple, deflected backward.†

Interfemoral membrane longer than tibia, semicircular. Calcar half the length of the

* The only other forms possessing the same armament are the remote genera *Vespertilio*, *Cerivoula*, *Natalus* and *Thyroptera*.

† In one specimen the tragus exhibited near the tip two papillæ seen on both the anterior and posterior borders and an additional cluster of three on the posterior surface.

tibia; the tip projects slightly beyond the interfemoral membrane; wing membrane attached at a point midway on metatarsus. Nose leaf acuminate, sparsely hairy. Internareal pedicle with midrib; below two warts at median line in the short lip; outer flange at the nostril broad, tumid and gland-bearing. The gland mass proper well defined, but not across the face back of the nose leaf.

Tail two-thirds the length of the femur and appearing free above the interfemoral membrane. Vibrissæ on muzzle very long. Fur everywhere silky. Above, tips dark brown, the remainder of hair lighter brown. Beneath, lighter in shade, light brown, unicolored. No. 399, Acad. Nat. Sci., is smaller than the specimen named. The length of forearm is 33 mm. (about 1".30), and shorter than that assigned *Chærnycteris minor* Peters. The calcaneum, however, is not as long as the foot. The central incisors are absent in the upper jaw. In other respects the specimen resembles *C. mexicana*. I do not identify this specimen with *C. minor*, but regard it as a variation of *C. mexicana*.

The Skull.—Skull papyraceous; the divisions of the cerebellum and cerebrum discernible through the periphery. Temporal ridge almost *nil*, not forming union at any part of the sagitta. Fronto-maxillary inflation absent, but the inner wall of the orbit and the fronto-nasal depression unite to form a ridge which bears a foramen. Face vertex without median fronto-nasal pit, but in its place a flat surface which bears a median ridge. No groove indicating positions of the nasal bones, but the outlines are seen through the translucent periphery. The sides of the face uniformly convex. The upper border of the anterior nasal aperture incised. The lateral margins of the anterior nasal aperture scarcely produced; the groove between them and the eminence over the canine teeth rudimental. The simple infraorbital foramen over the first premolar tooth.

Alveolar process in height one-thirty-first the width of the neck of the canine and one-thirteenth the vertical diameter of the anterior nasal aperture. Six inconspicuous rugæ. Zygoma incomplete. The infraorbital foramen on same vertical line between the second and third premolars. Hard palate acutely arched in molar range. The posterior border near root of zygoma with slightly convex margin; oval foramen well in advance of the pterygoid free tip which reaches the tympanic bone. The tympanic bone not reaching the postglenoid process. The palatal bone extends to the anterior lacerated foramen before forming the large subacuminate notch. Pterygoid process convex outward, forming bulla-like recesses. The mesopterygoid fossa with a faint vomerine ridge which is continuous with the conspicuous basioccipital ridge. The coracoid process acute, deflected outward, the angle produced beyond the condyloid process, and continuous with the depressed lower border of the masseteric impression. Symphysis with pronounced carination. Brain case, 16 mm. long; face, 14 mm. long; or the face almost as long as the brain case.

The Teeth.—Wide interval between upper incisors. The central as described by Dobson, is smaller than the lateral. But in two specimens examined by me the centrals were larger than the laterals. Both teeth are inconspicuous and scarcely raised above the gum line. The palatal surface of the slender canine flat. Of the two premolars present, the first possesses both anterior and posterior cingules and without increase of width back of the cusp. The second is without posterior cingule, but is widened back of the cusp. The first molar with paracone extending the entire length of the tooth, but sloping from before backward. Protocone and mesocone without buccal fluting or palatal ridges. The second molar as the first, but the protocone ends at the beginning of the mesocone. The third molar as the second much smaller and all parts rudimental.

The lower incisors deciduous. The slender canine with rudimental lingual cingule which does not extend beyond the level of the lateral incisor. The first premolar close to canine with cingule subequal to the cusp. The second and third premolars with cusp much larger than the prominent cingules. The first molar with protocone and paracone almost coalesced; the protocone well advanced. The posterior border of the tooth is furnished with a prominent cingule apparently developed from the hypocone. The first molar is separate from the third premolar and the second and third from one another.

Chœrnycteris exhibits vertical muscle fibres in the endopatagium, the nerve markings of the interdigital spaces and the shapes of the terminal cartilage of the fourth digit in a manner quite the same as in *Glossophaga*, though the structure last named is less spatulate than in that genus.

Measurements.—The first phalanx of the first digit shorter than the metacarpal; no phalanx is present in the second digit. The metatarsi and the first row of phalanges equal.

Tongue attached to floor of mouth at the level of the space between the second and the third molars, or 12 mm. from the symphysis. Penis not pendulous.

ANURA.

Interfemoral membrane hairy; tail absent; wing membrane attached to midtarsus; calcar absent; no phalanx to second digit; two warts on upper lip; groove in lower lip wide with many warts. First premolar large remote from canine.

Dental formula: $i. \frac{4}{4} - c. \frac{1}{1} - prm. \frac{3}{3} - m. \frac{3}{3} = 22$.

Resemblance to *Lonchoglossa* very close. The general appearance the same even to the shape of the terminal cartilages of the phalanges. Skull and number of the teeth the same. But it is held that the tail, calcar and phalanx to the second digit all being absent, separate *Anura* from the genus just named.

The first lower premolar possesses a small, anterior, basal cusp and is, therefore, almost as large as the other premolars. The main cusp throughout scarcely higher than the basal cusp.

Anura wiedii Peters.

Auricle much the same as in *Lonchoglossa*. The tip of the tragus is pointed. Nose leaf simple, acuminate, no depression above nostrils. The gland mass at the side of the nostril continuous with that extending up to the side of the nose leaf. Upper lip with two equidistant warts. Fur everywhere long and silky. Above, apical third dark brown, basal two-thirds Isabella brown. Below, apical third Isabella brown; basal two-thirds dark gray. Thus the arrangement of color is boldly contrasted with that of other forms in the group. Fleshy mass of forearm, the interfemoral membrane, the thigh and the feet covered with short hair. On the ventral aspect the forearm is covered with fur which extends thence a short distance on the interfemoral membrane.

The proportions of the wing of *Anura* are those of a larger animal than *Lonchoglossa*, though the thumb is of the same size. The lower extremities are almost identically the same in size, the calcar alone being larger in *Lonchoglossa*. The absence of the phalanx has already been noted in *Chærnycteris*. Alliance with this genus is suggested in the great width of the cleft in the lower lip and in the possession of warts on the upper lip.

The muscle fascicles and membrane markings are as in *Glossophaga*, but the terminal cartilages of the fourth digital interspace while spatulate exhibit the limb on the somad side greatly prolonged. This character is not seen elsewhere in the group. The cartilage of the fifth digit while terete is also greatly prolonged on the free margin of the endopatagium. These characters indicate that there is more strain on the wing during flight than in any other genus.

The Skull.—The skull is almost identical with that of *Lonchoglossa*. The alveolar height is one-third the width of the neck of the canine and one-seventh the vertical diameter of the anterior nasal aperture. The zygoma by careful maceration is shown to be cartilaginous. A specimen of *Lonchoglossa* shows the same structure. The skull is 24 mm. long. The brain case is 60 mm. long, and the face 40 mm. The lower border of the masseteric impression is not produced. Dobson's figure, Pl. XXVII, Fig. 4, does not agree in all respects with our example.

In 1830, Rengger (*Naturgesch. der Säugeth. von Paraguay*, 80) described a species of bat under the name *Glossophaga villosa*. Since Wagner (*Suppl. Schreb. Säugeth.*) assigns this form a place under *Chærnycteris*, it is well to state that while *G. villosa* Rengger retains three premolars in both jaws, that the tail is absent, the interfemoral

membrane is but half an inch deep at the rump, and the lateral upper incisors are smaller than the centrals. The interfemoral membrane is hairy. This species is nearer *Anura* in most of its characters than any other genus in the group.

LONCHOGLOSSA.

Tail short; wing membrane attached to ankle; calcar present but small, about one-third the length of the tibia; a phalanx to second digit; groove in lower lip narrow with a few inconspicuous warts; no warts on upper lip; basal part of nose leaf rudimental; apical third of tongue filamentose; interfemoral membrane not hairy.

Dental formula: i. $\frac{4}{4}$ — c. $\frac{1}{1}$ — p. $\frac{3}{3}$ — m. $\frac{3}{3}$ = 22.

The first lower premolar small and without anterior, basal cusp; the main cusps of the entire series twice the height of the basal cusps.

The presence of the tail and a phalanx to the second digit are sufficient grounds to separate *Lonchoglossa* from *Anura*.

Lonchoglossa caudifera Geoff.

Auricle pointed, internal basal lobe bound down to head. External border faintly sinuate scarcely; any external basal lobe; the inner lappet large. Tragus blunt at tip. Nose leaf simple, without pedicle; lateral gland mass of base rudimental; upper lip short, without warts.

Large numerous vibrissæ from face, especially from mentum. Filaments on tongue large, not meeting in middle line of dorsum. Wing membrane reaches to calcar. Seven rugæ on the hard palate, the last two alone divided. The tail not quite as long as the short interfemoral membrane, the tip not free.

The hair of the dorsum exhibits apical third brown, basal two-thirds pallid. Beneath paler, prevailing hue brown (but with scarcely a contrasted shade toward base), tending to become grayer, almost unicolored on loin. Limbs naked.

The wing markings both in the nerves and muscle fascicles are as in *Glossophaga*, but the terminal cartilage of the fourth digit is terete, and that of the fifth digit is small and scarcely deflected.

The Skull.—The bones very thin, permitting the subdivisions both of cerebellum and cerebrum to be seen through the periphery. The pretemporal ridge unites with its fellow at the anterior fourth to form a faint, linear crest; the mesotemporal and post-temporal ridges not separately defined, scarcely discernible. Fronto-maxillary inflation small. Face vertex without pit at the fronto-nasal region; outlines of nasal bones not defined. Side of face convex. The lateral borders of the anterior nasal aperture moderately produced. The foramina between the two premaxillæ near the incisor margin large.

The alveolar process so slender that it cannot be measured. The parts as viewed from in front embrace the floor of the nasal chambers at the premaxillary part and permit the median foramen to be seen. The zygoma without a trace of ascending process. The posterior palatal margin near the root of zygoma spinose; the posterior palatal notch with conspicuous spines. Pterygoid process almost reaching tympanic bone and extends beyond the oval foramen. Mastoid process aciculate. Mesopterygoid fossa with inconspicuous vomerine spine. Basioccipital depressions shallow. The coronoid process scarcely raised above the level of the condyloid process. The deflected hamular angle projects in a marked degree beyond the condyloid. The lower border of the masseteric impression is produced conspicuously beyond the border of the ramus. Symphysis with large keel. One skull 21 mm. long; face 8 mm. long; brain case 15 mm. long.

Upper Teeth.—The small central incisors separated by wide interval, and each tooth in close contact with the large lateral. The central incisor with ovoid crown scarcely wider than neck; the lateral incisor projecting below the level of the central with crown wider than neck and conspicuously oblique outer border. The interval between lateral incisor and the canine no greater than in other genera. Canine with inner surface flat. First premolar one-half the size of the others; separated from the canine and the second premolar, but nearer the last-named tooth. The second and third premolar triangular, with large basal cingules.

The W-pattern of the molars discernible. In one specimen the long, sloping protocone with suggestion of hypocone, recalling the parts as in *Macrotus*; in the second the teeth were without hypocone. Canine with rudimental heel. First premolar separate from the canine and second premolar. Second premolar separate from the first and third; third premolar separate from the second, but contiguous to the first molar. First molar with cingule of the protocone extended forward, scarcely deflected inward and overlapping third premolar; protocone and paracone approximate, united at base.

Lower Teeth.—First lower premolar without anterior basal cusp, and is, therefore, much smaller than the other premolars. In the entire series of premolars the main cusp is twice as high as the height of the basal cusps. The first and second molars of the same plan with the foregoing, the third being slightly the smaller.

The lower teeth with jaw are figured by Leche (*l. c.*, Taf. II, Fig. 8). The first premolar is represented as being exactly like others of the series. This character would prevent the *Lonchoglossa* of Leche's identification being received under *Lonchoglossa caudifera* of this essay.

Variations.—The above description is based on two specimens, which were subject to some variation. In one the pretemporal crests did not unite. In one the cusps of the teeth were much worn.

Notes on the Skeleton.—Ribs thirteen; first costal cartilage not wider than the rib. Humerus with pectoral crest relatively high, one-half the diameter of distal end of bone. The sternal crest after careful removal of the pectorals is very high and apparently without notch, but the greater part of the interpectoral septum is membranous. The phalanx of the second digit about as in *Vespertilio*. The metatarsi and first row of phalanges of toes equal.

Measurements.—Forearm, 36 mm.; foot and thumb of same length, viz., 8 mm.; forearm, 1.35 mm.

BRACHYPHYLLINA.

I propose to establish the Brachyphyllina to include the genera *Brachyphylla*, and *Phyllonycteris*,* forms which have hitherto been assigned separate groups in the Phyllostomidæ, the first named to the Stenodermata and the second to the Glossophagina.

Brachyphyllina.

Leaf-nosed bats with tip of tongue retaining clump of papillæ extending across dorsum. In the Glossophagina the papillæ are arranged not only at the tip but the sides for great lengths. The minute first upper premolar wedged in between the canine and large second premolar; coronoid process acute, raised high above the level of the condyloid process. Mesopterygoid fossa deep, apex answers to the junction of the anterior and middle third of the zygoma. Nasal bones high, arched, defining a depression between them and the maxilla. Sagitta entire with well-defined pretemporal crests. The glands of muzzle continuous behind nose leaf. Thumb large, one-fourth the length of the forearm, nearly. Auricle narrow, oval with pointed tip. Tragus coarsely serrate entire length of outer border. Upper lip hairy, without warts. Lower lip with shallow median groove, margined with large warts. Lips not fringed internally.

BRACHYPHYLLA.

Upper central incisors very much larger than the laterals. Length of forearm, 65 mm.; that of thumb, 16 mm., this being about one-fourth the length of the forearm as in *Phyllonycteris*. Grinding surfaces of molars with numerous large mammillations, cuspidation distinct. Angle of lower jaw quadrate, massive; nostril entire, the wide outer margin and the side of the rudimental nose leaf continuous. Tragus entire on inner border. The tail rudimental, one-fourth the length of tibia, and concealed in the inter-femoral membrane.

Dental formula: i. $\frac{4}{4}$ — c. $\frac{1}{1}$ — prm. $\frac{2}{2}$ — m. $\frac{3}{3}$ = 20.

* I have not studied *Rhinophylla*, but the conclusions arrived at after reading the accounts of Peters and Dobson induce me to place the genus in the same alliance with genera just named. But in the absence of material I am compelled to confine my comparisons to *Brachyphylla* and *Phyllonycteris*.

Brachyphylla cavernarum Gray.

The auricle lanceolate with slightly convex margins, basal lobes rudimental. The tragus pointed, one-half the length of the inner margin of the auricle; convex on thickened inner, and coarsely serrate on outer, margin.

Nose leaf with entire nostrils and wide ectonareal flange; erect portion of nose leaf rudimental—concave and often minutely crenulate on midmargin. Supranarial margin concave on either side of an obscure median ridge. Infranarial margin wide, continuous with upper lip and faintly incised. The basal gland-clump continuous across face—vertex back of nose leaf. The upper and outer parts are thick and bear a few coarse bristles, while the lower are thin and lost on the upper lip. Twelve warts are arranged in pairs on the side of a mental V-shaped group, the median groove being shallow. Two median warts may be said to have slight morphological significance.

The fur above is yellowish white except the tip, which is brown. Below the tints are the same, but the shaft is more tawny and the tips much lighter. The distal third of the arm above and below is covered with hair. The distal half of the thigh is similarly covered. A sparse growth of hair is limited to the upper half of the dorsal surface of the interfemoral membrane.

The calcar is rudimental. The terminal cartilages of the fourth and fifth digits are uniform, elongated and scarcely wider at free margin than on the sides. The second interdigital space is almost devoid of pigment. The third space retains a vertical line for nearly its entire length, while the fourth exhibits one for about an inch near the free margin, the rest of the space being areolated. The endopatagium is furnished with numerous thick muscle fascicles; near the tibia it is thick and leathery.

Pteral formula:	Second interspace,	Third interspace,	Fourth interspace,
	3 mm.	19 mm.	35 mm.

The Skull.—The walls of the skull are thin and permit the divisions of the brain to be discerned. The sagittal, pretemporal and occipital crests are well defined and trenchant. The fronto-maxillary inflation is conspicuous and bears the pretemporal crest. The inner orbital wall is moderately convex, and is marked by a conspicuous foramen. The infraorbital foramen is placed well in advance of the orbit in line of the second premolar. The zygoma with a rudimental ascending process at the posterior third, but none anteriorly to contribute to the limitation of the orbit.

Lower Teeth.—The incisors are stout, in continuous row. The palatal basal cusp is on level with the crown, which thus presents a broad, quadrate surface, marked in the middle from before backward by a ridge. Canine without conspicuous basal cusp. Premolars subequal, the first the smaller and triangular, the second with large basal cusp.

First and second molars with quadritubercular cusps well defined, a large mammillation on the anterior commissure of the second molar; the third molar triangular, tritubercular.

Upper Teeth.—The central incisors are very large, triangular, nearly filling the interval between the canines. The lateral incisors are minute, not over one-fourth the size of the centrals. The anterior surface is concave; the crown is blunt and quadrate, with basal cusp and cutting edge equal. The canine with anterior and posterior denticles, the posterior of the two being enormous and presenting the aspect of being an outshoot from the side of the crown. The first premolar minute and of the same form as the lateral incisor. The second premolar large, triangular and projecting beyond the molars. The basal cusp (denterocone) conspicuous. Molars tritubercular, without W-shaped pattern. Several mammillations are present on the grinding surfaces. Third molar is one-half the size of the second.

Measurements of Brachyphylla cavernarum.

	Millimeters.
Head and body (from crown of head to base of tail).....	66
Length of arm.....	40
Length of forearm.....	65
First digit:	
Length of first metacarpal bone.....	4
Length of phalanges.....	12
Second digit:	
Length of second metacarpal bone.....	46
Length of first phalanx.....	5
Third digit:	
Length of third metacarpal bone.....	55
Length of first phalanx.....	17
Length of second phalanx.....	23
Length of third phalanx.....	11
Fourth digit:	
Length of fourth metacarpal bone.....	51
Length of first phalanx.....	15
Length of second phalanx.....	17
Fifth digit:	
Length of fifth metacarpal bone.....	55
Length of first phalanx.....	15
Length of second phalanx.....	14
Length of head.....	34
Height of ear.....	12
Height of tragus.....	9
Length of thigh.....	23
Length of tibia.....	27
Length of foot.....	29
Length of interfemoral membrane.....	21
Length of tail.....	7

PHYLLONYCTERIS.

Upper incisors separated from the laterals by wide intervals; naked skin-fold defining nostrils laterally; nose leaf not reaching above the level of approximate club-shaped gland masses. Thumb the largest in the group nearly one-fourth the length of the forearm. Length of forearm, 45 mm. Teeth with cusps nearly obliterated, no W-pattern on molars. Large vacuity between occipital bone and pars-squamosal of the temporal. Fimbriæ not arranged in rows, but form a uniform covering to the tip of the tongue. The first and fifth metatarsal bones longest. The first row of phalanges of third to fifth digit of manus, same length as the second row. Calcar wanting. Zygomatic arches fibro-cartilaginous.

Dental formula : i. $\frac{4}{4}$ — c. $\frac{1}{1}$ — prm. $\frac{2}{3}$ — m. $\frac{3}{3}$ = 21.

Phyllonycteris was described by Gundlach, but published under the care of Peters, who does not appear to have known the form. Gundlach correctly compares the genus to *Brachyphylla*. Dobson follows Gundlach closely, his description being little more than a translation of the original article. When he departs from the text he makes statements which do not agree with the specimen on which the present essay is based. Thus he says, "the incisors are as in *Glossophaga*; the molars like those of *Carollia* (*Hemiderma*), but the W-shaped cusps scarcely developed;" whereas the upper lateral incisor is twice the size of the central and the zygoma may be complete. With the exception of the skulls, Dobson did not study *Phyllonycteris* at first hand.

Phyllonycteris sezeorni Gundl.

Auricle simple, ovate, with rounded pointed tip. External outline without subdivision or inner lappet near the base. Internal basal lobe scarcely free. Tragus convex on inner side, straight on outer. Both sides marked by three, coarse, teeth-like processes. Basal point scarcely longer.

Nose leaf simple, obtuse with internarial pedicle. The perinarial flange is lamellar and distinct from gland mass. The structure last named well defined, apparently crossing muzzle back of the nose leaf, but two club-shaped masses are nearly approximate. Upper lip high without warts. Interfemoral membrane deeply incised, extending from distal third of the tail to the calcaneum. The tail is short, scarcely projecting beyond the interfemoral membrane. The fur long and silky above, light gray tipped, subtip sooty, the rest of the hair pale verging to white. Beneath much paler, nearly uniform gray. The tip of hair tawny, the rest of the hair of a somewhat lighter shade.

Almost the entire field of the endopatagium filled with widely separated nearly equidistant vertical muscle fascicles. There is no reticulated arrangement of fibres. The

nerve markings in the fourth interspace as in *Glossophaga* except that from the fourth digit there are three instead of one nerve. The terminal cartilage of the fourth digit is obscurely spatulate.

The Skull.—The skull not papyraceous, the division of the cerebellum, but not of the cerebrum, discernible on periphery. The pretemporal crest distinct. It begins over the moderate fronto-maxillary inflation to form a delicate crest by union with the fellow of the opposite side at the anterior third of the sagitta. Mesotemporal and posttemporal crests not discerned. The orbital ridge is rudimental, but the frontonasal pit conspicuous at proximal end of the slightly convex nasal bones. The large infraorbital foramen lies over interval between second premolar and first molar and is thatched by a ridge. The alveolus (*i. e.*, the distance from the central incisor to the anterior nasal aperture) equals in height one-fifth of the base of the upper canine and one-eighteenth of the vertical diameter of the large, anterior, nasal aperture. The zygoma often complete.* The maxilla at root of zygoma with a very small ascending process. The premaxilla at the side of the anterior nasal aperture salient. Neither the groove between the nasal bones or the depression on the maxilla at the side of the nasal bones are conspicuous. The depression between the aperture last named and the eminence over the canine is shallow. The hard palate just back of the last molar is sharply defined by a double crescentic transverse ridge; the palatal notch is acute and deep, the apex reaching the level of the anterior third of the zygomatic arch, the pterygoid process corresponding in position to the oval foramen. The tympanic bone touches the postglenoid process. The junction of the ethmoid and sphenoid bones in the brain case not convex. A vacuity is found in the line of junction of occipital and squamosal bones.

The basioccipital bone with scarcely any pit-like depressions; the vomerine ridge scarcely discernible in the mesopterygoid fossa. The mastoid process small, conical. The proportion of the face to the brain case is as 9 to 15 mm.

Lower Jaw.—Coronoid process acuminate. The hamular angle not deflected or projected beyond the condyloid process; lower border of the masseteric impression not distinguished from the corresponding border of the horizontal ramus. Back of the molars and at base of coronoid process a tubercle for insertion of temporal muscle is seen. Symphysis-menti broad, non-carinate, the surface near the incisors marked by coarse venous foramina.

The Teeth.—The upper central incisors hatchet-shaped, contiguous; laterals much smaller, not half the size of centrals and separate therefrom. The incisors not entirely occupying space between the canines. Canine broad at base, robust, convex entire length

* Dobson (*Cat. Chirop. Br. Mus.*) in text states that they are incomplete, but acknowledges the fibro-cartilagium arch in a footnote.

of palatal surface. First premolar very small, nodular, about one-fourth the size of the second and not much larger than the lateral incisor. Second premolar triangular, without basal cusp; posterior half of palatal surface concave. Molars without well-defined cusps and decrease in size gradually from before backward. The third molar one-half the size of the second. The protocone, paracone and metacone scarcely indicated; no W-shaped pattern.*

Lower lateral incisors twice the size of the centrals; all are non-contiguous and nodular. Canine with conspicuous concave heel; all other parts convex; cingulum extends inward so as to lie back of the lateral incisor. The premolars thick and robust, subequal; the first smaller. The molars decreasing in size from before backward without details.

Of the measurements it is noted that the first phalanx of the first digit is scarcely longer than the metacarpal bone. In the second digit the single phalanx is one-tenth the length of the corresponding metacarpal bone. The entire second digit is as long as the third metacarpal bone. In the third digit the first and second phalanges are equal—the third phalanx is nearly one-half the length of the second. The terminal cartilage of the fourth digit is moderately spatulate, and that of the fifth digit is deflected toward the body. The wing membrane attached to the tibia at the distal seventh or to the ankle. Interfemoral membrane attached to tip of the small calcaneum.

The Skeleton.—The sternum is boldly keeled over the presternum and metasternum. The ribs are twelve in number. The first costal cartilage is discoidal. The humeral pectoral crest is relatively low and not half the diameter of the proximal end of the bone. The fifth metatarsal bone is much the largest of the series. Palatal rugæ eight, last three to four interrupted in centre. The first and fifth metatarsals are longer than the others. The bones of the first row of phalanges of the toes are equal.

* Peters and writers following him give all glossophagine genera W-shaped pattern of molars. I have had no opportunity of examining the type of *Phyllonycteris* in the Berlin Museum, but I have received through the kind offices of Mr. Paul Matschie a photograph of the skull which I find conforms to the account above given.

Table of Measurements (in millimeters).

	<i>Glossophaga soricina.</i>	<i>Glossophaga truei.</i>	<i>Leptonycteris nivalis.</i>	<i>Chernycteris mexicana.</i>	<i>Lonchoglossa caudifera.</i>	<i>Anura wiedii.</i>	<i>Phyllonycteris sezecorni.</i>
Head and body (from crown of head to base of tail).....	45	45	57	55	40	42	32
Length of arm.....	19	?		20	20	20	25
Length of forearm.....	36	32	50	42	35	38	45
First digit :							
Length of first metacarpal bone	4	4	4	4	3	3	5
Length of first phalanx	4	4	4	3	3	3	7
Second digit :							
Length of second metacarpal bone.....	30	25	40	40	29+	33	33
Length of first phalanx.....	1	2	3	0	2	0	3
Third digit :							
Length of third metacarpal bone.....	34	30	47	45	37	38	38
Length of first phalanx.....	13	11	14	17	12	13	14
Length of second phalanx.....	16	12	23	21	18	21	14
Length of third phalanx.....	7	6	8	9	9	11	8
Fourth digit :							
Length of fourth metacarpal bone.....	33	27	42	40	34	37	35
Length of first phalanx	10	9	11	12	9	10	13
Length of second phalanx.....	10	9	16	15	12	13	11
Fifth digit :							
Length of fifth metacarpal bone.....	30	27	40	35	30	30	35
Length of first phalanx.....	9	8	10	10	7	8	11
Length of second phalanx.....	9	8	10	13	11	12	10
Length of head.....	23	21	27	32	25	29	25
Height of ear.....	14	11	12	13	13	14	11
Height of tragus	4	3	4	5	4	4½	5
Length of thigh.....	10	?	15	15	13	14	19
Length of tibia	14	11	20	17	13	13	20
Length of foot.....	8	8	12	10	7	7	13
Length of interfemoral membrane in median line.....	10	9		20	4	6	7
Length of tail.....	5	?		8	4	0	10

NOTE.—The Secretaries deem it proper to state that this, as well as the succeeding paper, was presented to the Society after the author's death, which lamented event occurred on November 14, 1897, and that, therefore, it has not had the benefit of his revision in its passage through the press.

EXPLANATION OF THE PLATES.

PLATE VI.

- Fig. 1. *Glossophaga soricina*. Head seen from in front. $\times 2$.
 Fig. 2. *Glossophaga soricina*. Skull vertex. $\times 3$.
 Fig. 3. *Glossophaga soricina*. Skull profile. $\times 3$.
 Fig. 4. *Glossophaga soricina*. Skull base. $\times 3$.
 Fig. 5. *Glossophaga soricina*. Jaws with incisors and canines seen from in front. $\times 8$.
 Fig. 6. *Glossophaga soricina*. Upper teeth. $\times 10$.
 Fig. 7. *Glossophaga soricina*. Lower teeth seen from above. $\times 10$.
 Fig. 8. *Glossophaga soricina*. Left lower molars seen in profile from lingual aspect. The first molar is to the right. $\times 10$.

PLATE VII.

- Fig. 9. *Glossophaga truei*. Head seen from in front. $\times 2$.
 Fig. 10. *Glossophaga truei*. Skull vertex. $\times 3$.
 Fig. 11. *Glossophaga truei*. Skull profile. $\times 3$.
 Fig. 12. *Glossophaga truei*. Skull base. $\times 3$.
 Fig. 13. *Glossophaga truei*. Upper teeth. $\times 8$.
 Fig. 14. *Glossophaga truei*. Lower teeth seen from above. $\times 8$.
 Fig. 15. *Glossophaga truei*. Left lower molars seen in profile from lingual aspect. The first molar is to the right. $\times 8$.

PLATE VIII.

- Fig. 16. *Monophyllus redmani*. View of head from in front, showing ear and nose leaf. $\times 2$.
 Fig. 17. *Monophyllus redmani*. Skull of same. Norma verticalis. $\times 3$.
 Fig. 18. *Monophyllus redmani*. Skull of same. Norma lateralis. $\times 3$.
 Fig. 19. *Monophyllus redmani*. Skull of same. Norma basilaris. $\times 3$.
 Fig. 20. *Monophyllus redmani*. Upper and lower jaws seen from in front. $\times 8$.
 Fig. 21. *Monophyllus redmani*. Teeth of the same as seen from the surfaces of crowns. $\times 8$.

PLATE IX.

- Fig. 22. *Brachyphylla cavernarum*. View of head showing ears and nose leaf.
 Fig. 23. *Brachyphylla cavernarum*. Skull of same. Norma verticalis. $\times 3$.
 Fig. 24. *Brachyphylla cavernarum*. Skull of same. Norma lateralis. $\times 3$.
 Fig. 25. *Brachyphylla cavernarum*. Skull of same. Norma basilaris. $\times 3$.
 Fig. 26. *Brachyphylla cavernarum*. Upper and lower jaws seen from in front. $\times 8$.

PLATE X.

- Fig. 27. *Brachyphylla cavernarum*. Teeth of same seen from the surfaces of crowns. $\times 8$.
 Fig. 28 to 39. *Brachyphylla cavernarum*. Terminal cartilages of the fourth and fifth digits.

PLATE XI.

- Fig. 40. *Leptonycteris nivalis*. Head seen from in front. $\times 2$.
 Fig. 41. *Leptonycteris nivalis*. Skull vertex. $\times 3$.
 Fig. 42. *Leptonycteris nivalis*. Skull profile. $\times 3$.
 Fig. 43. *Leptonycteris nivalis*. Skull base. $\times 3$.
 Fig. 44. *Leptonycteris nivalis*. Jaws with incisors and canines seen from in front. $\times 8$.
 Fig. 45. *Leptonycteris nivalis*. Upper teeth. $\times 8$.

Fig. 46. *Leptonycteris nivalis*. Lower teeth. $\times 8$.

Fig. 47. *Leptonycteris nivalis*. Left lower molars seen in profile from lingual aspect. The first molar is to the right. $\times 10$.

PLATE XII.

Fig. 48. *Chærnycteris mexicana*. Head seen from in front. $\times 2$.

Fig. 49. *Chærnycteris mexicana*. Skull vertex. $\times 3$.

Fig. 50. *Chærnycteris mexicana*. Skull profile. $\times 3$.

Fig. 51. *Chærnycteris mexicana*. Skull base. $\times 3$.

Fig. 52. *Chærnycteris mexicana*. Jaws with incisors and canines seen from in front. $\times 8$.

Fig. 53. *Chærnycteris mexicana*. Upper teeth. $\times 10$.

Fig. 54. *Chærnycteris mexicana*. Lower teeth. $\times 10$.

Fig. 55. *Chærnycteris mexicana*. Left lower molars seen in profile from lingual aspect. The first molar is to the right. $\times 10$.

PLATE XIII.

Fig. 56. *Lonchoglossa caudifera*. Head seen from in front. $\times 2$.

Fig. 57. *Lonchoglossa caudifera*. Skull vertex. $\times 3$.

Fig. 58. *Lonchoglossa caudifera*. Skull profile. $\times 3$.

Fig. 59. *Lonchoglossa caudifera*. Skull base. $\times 3$.

Fig. 60. *Lonchoglossa caudifera*. Jaws with incisors and canines seen from in front. $\times 8$.

Fig. 61. *Lonchoglossa caudifera*. Upper teeth. $\times 8$.

Fig. 62. *Lonchoglossa caudifera*. Lower teeth. $\times 8$.

Fig. 63. *Lonchoglossa caudifera*. First and second right lower molars seen from lingual aspect. The first tooth is to the right. $\times 10$.

PLATE XIV.

Fig. 64. *Anura wiedii*. Head seen from in front. $\times 2$.

Fig. 65. *Anura wiedii*. Skull vertex. $\times 3$.

Fig. 66. *Anura wiedii*. Skull profile. $\times 3$.

Fig. 67. *Anura wiedii*. Skull base. $\times 3$.

Fig. 68. *Anura wiedii*. Jaws seen from in front showing incisors and canines. $\times 8$.

Fig. 69. *Anura wiedii*. Upper teeth. $\times 8$.

Fig. 70. *Anura wiedii*. Lower teeth. $\times 8$.

Fig. 71. *Anura wiedii*. Left lower molars seen from lingual aspect. The first tooth is to the right. $\times 10$.

PLATE XV.

Fig. 72. *Phyllonycteris sezeorni*. Head from in front. $\times 2$.

Fig. 73. *Phyllonycteris sezeorni*. Skull vertex. $\times 3$.

Fig. 74. *Phyllonycteris sezeorni*. Skull profile. $\times 3$.

Fig. 75. *Phyllonycteris sezeorni*. Skull base. $\times 3$.

Fig. 76. *Phyllonycteris sezeorni*. Upper teeth. $\times 10$.

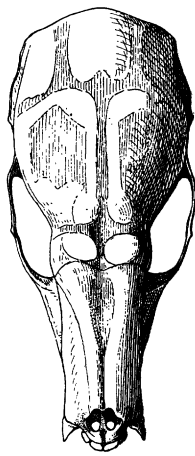
Fig. 77. *Phyllonycteris sezeorni*. Lower teeth. $\times 10$.

Fig. 78. *Phyllonycteris sezeorni*. Jaws seen from in front showing incisors and canines. $\times 8$.

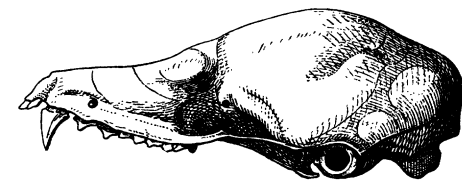
Fig. 79. *Phyllonycteris sezeorni*. Left lower molars seen from lingual aspect. The first tooth is to the right. $\times 10$.



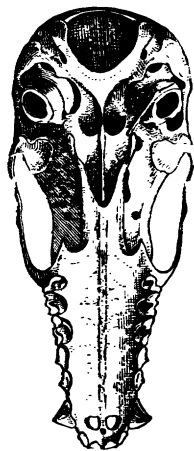
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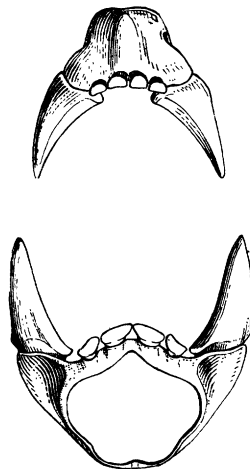
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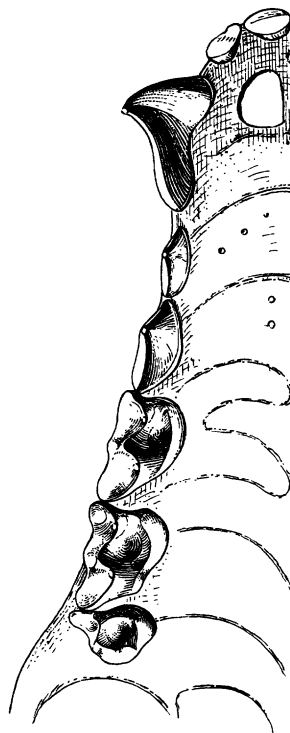
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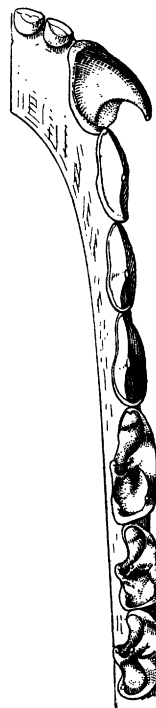
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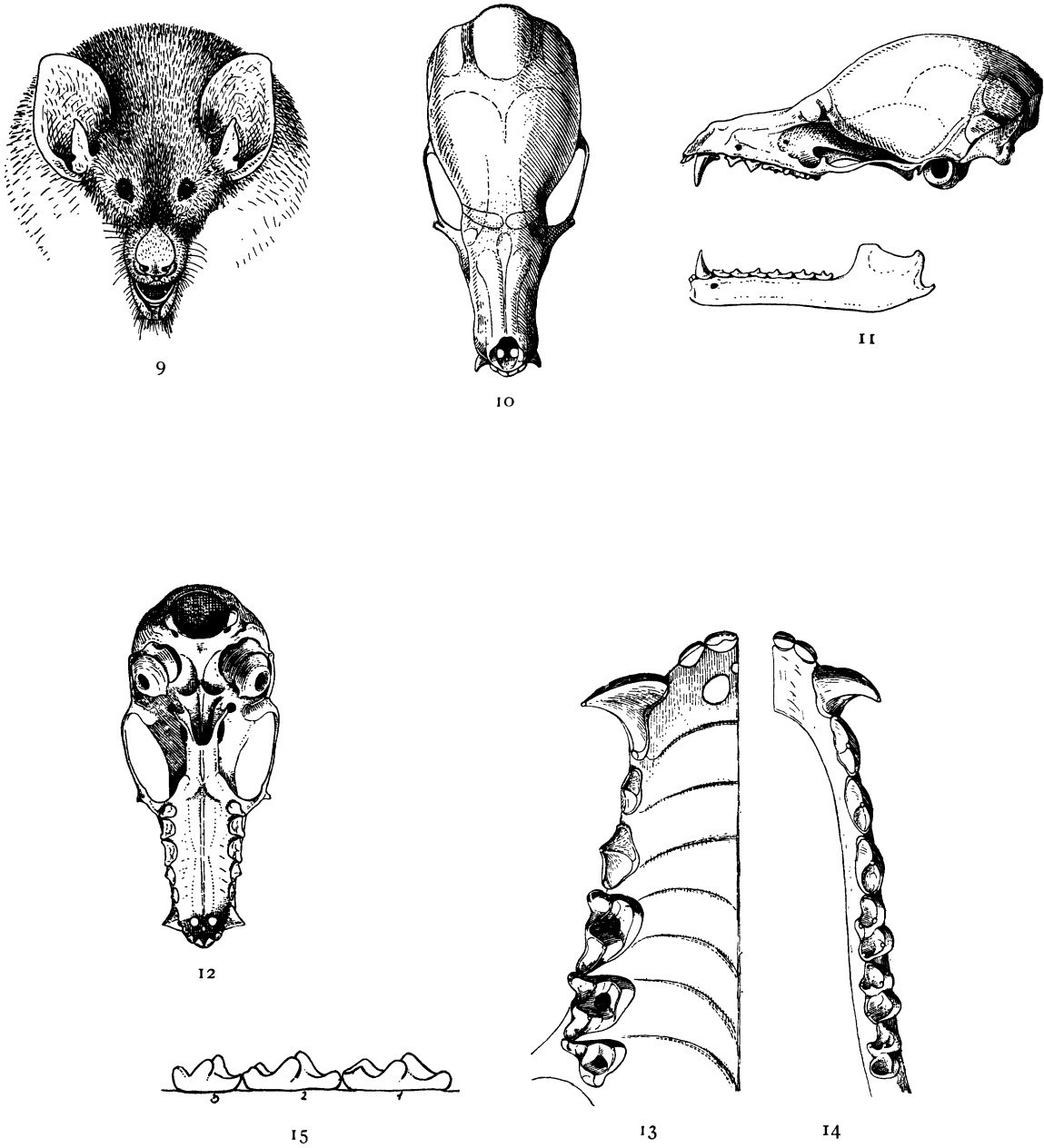
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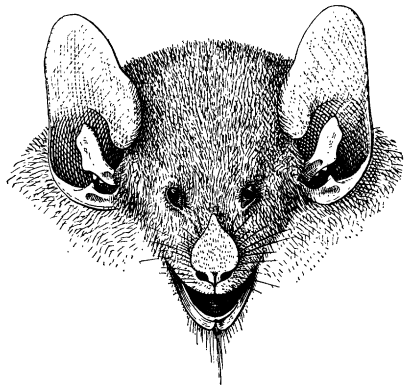
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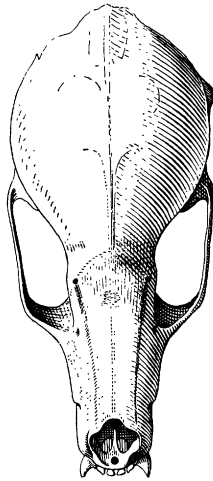
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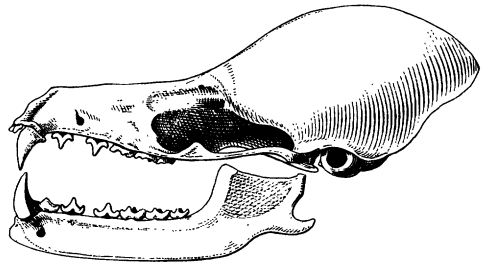
GLOSSOPHAGA TRUEI.



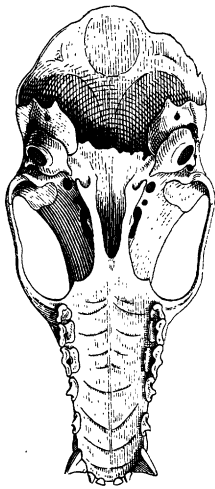
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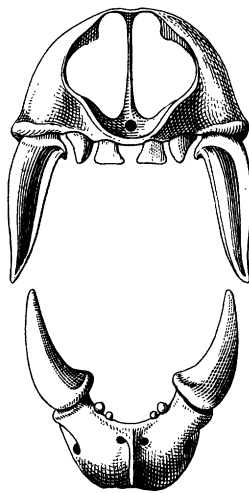
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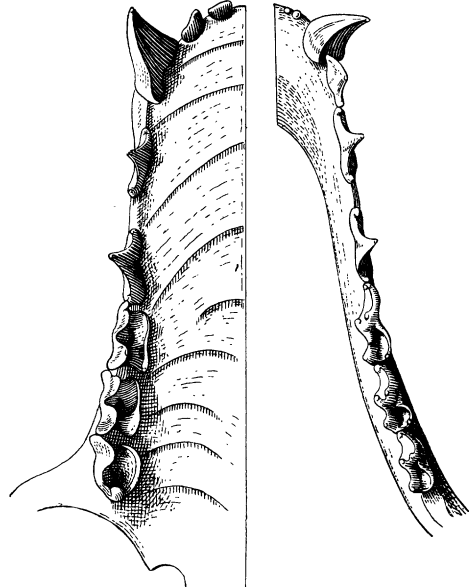
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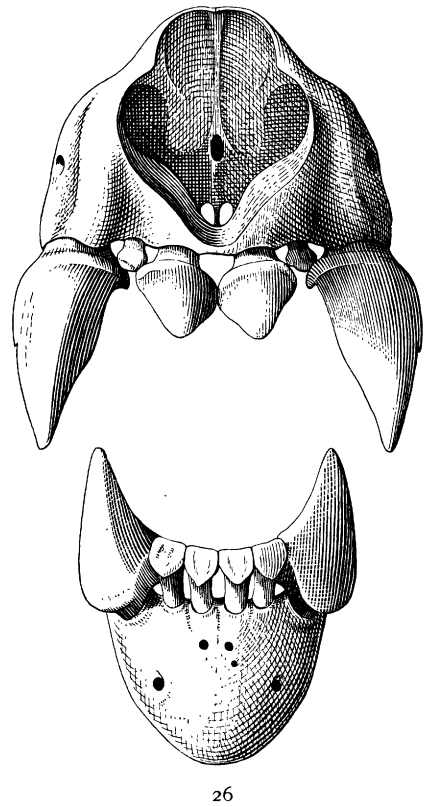
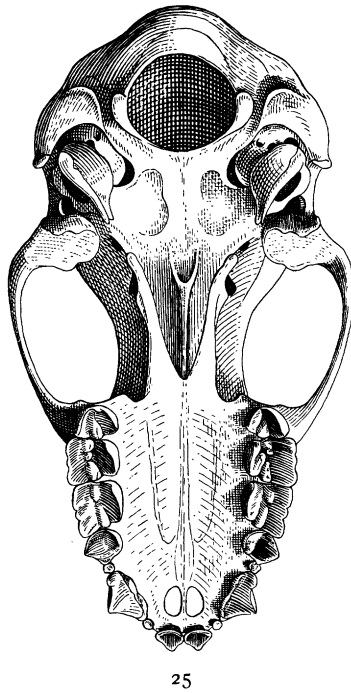
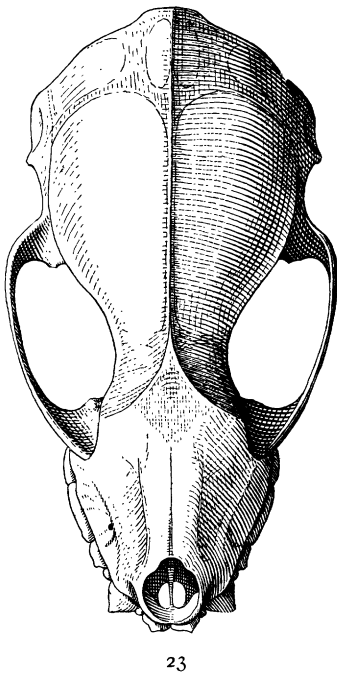
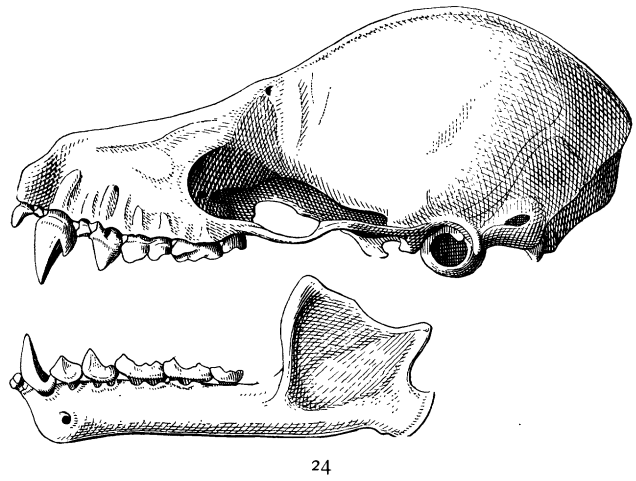


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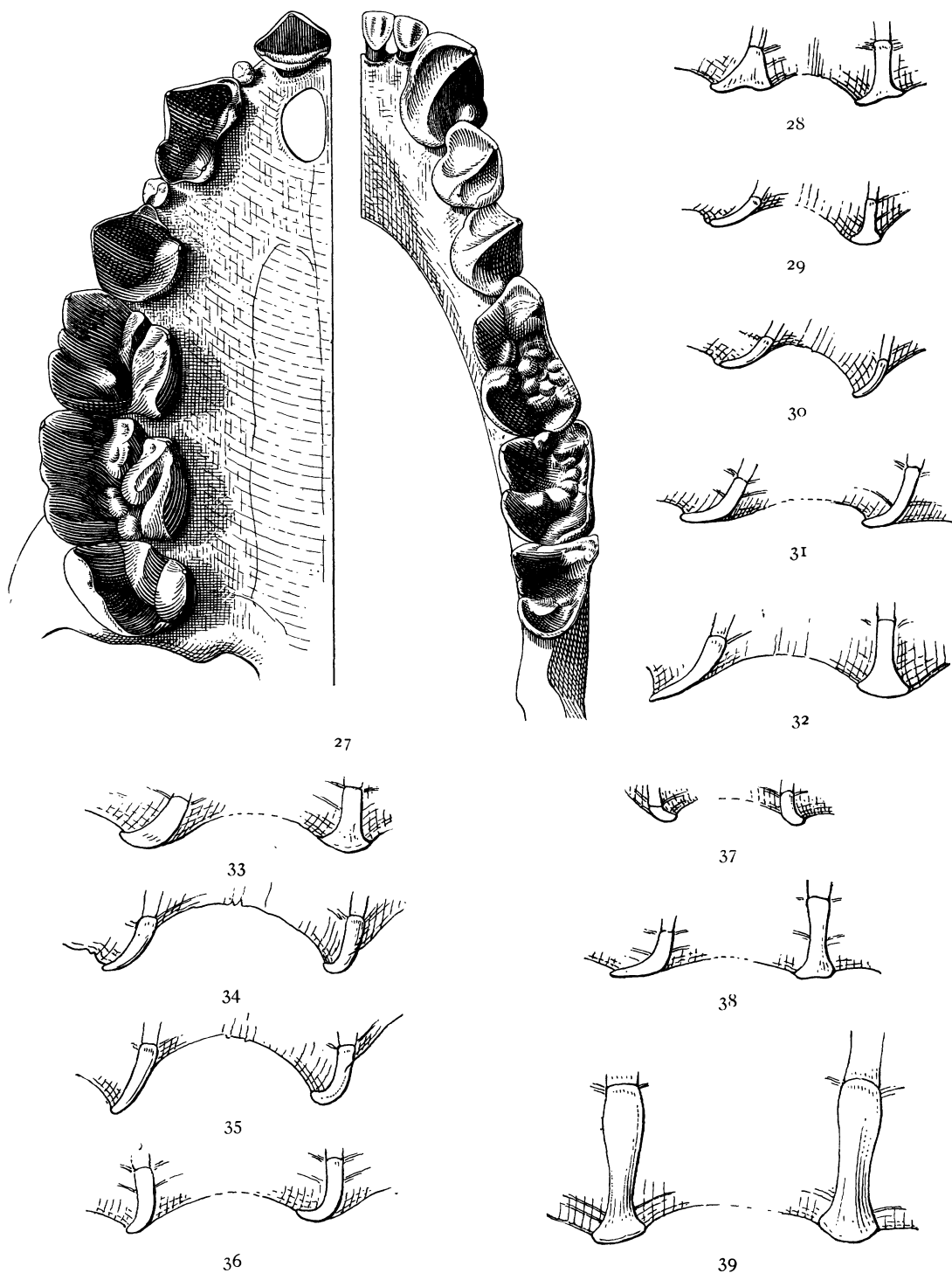


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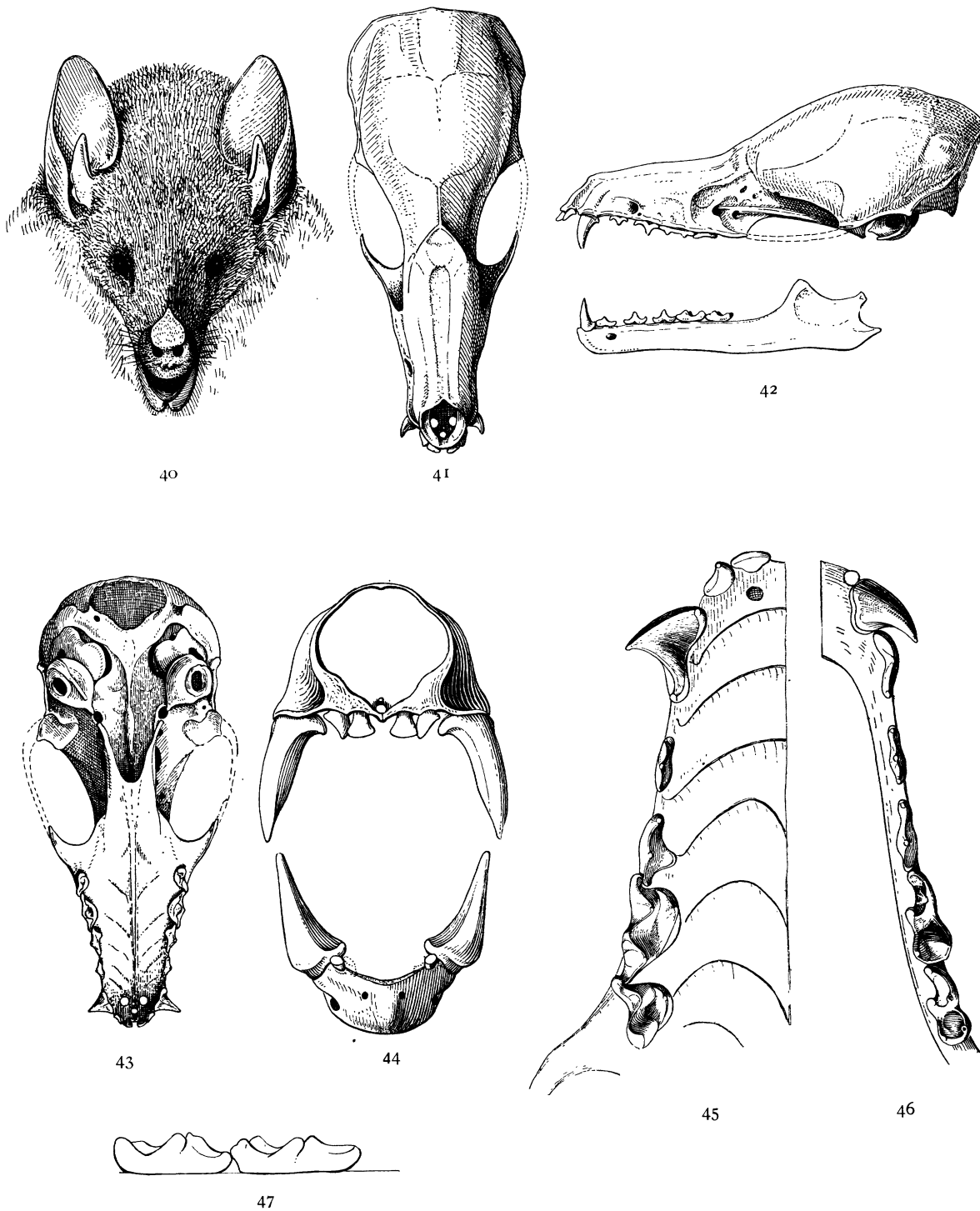
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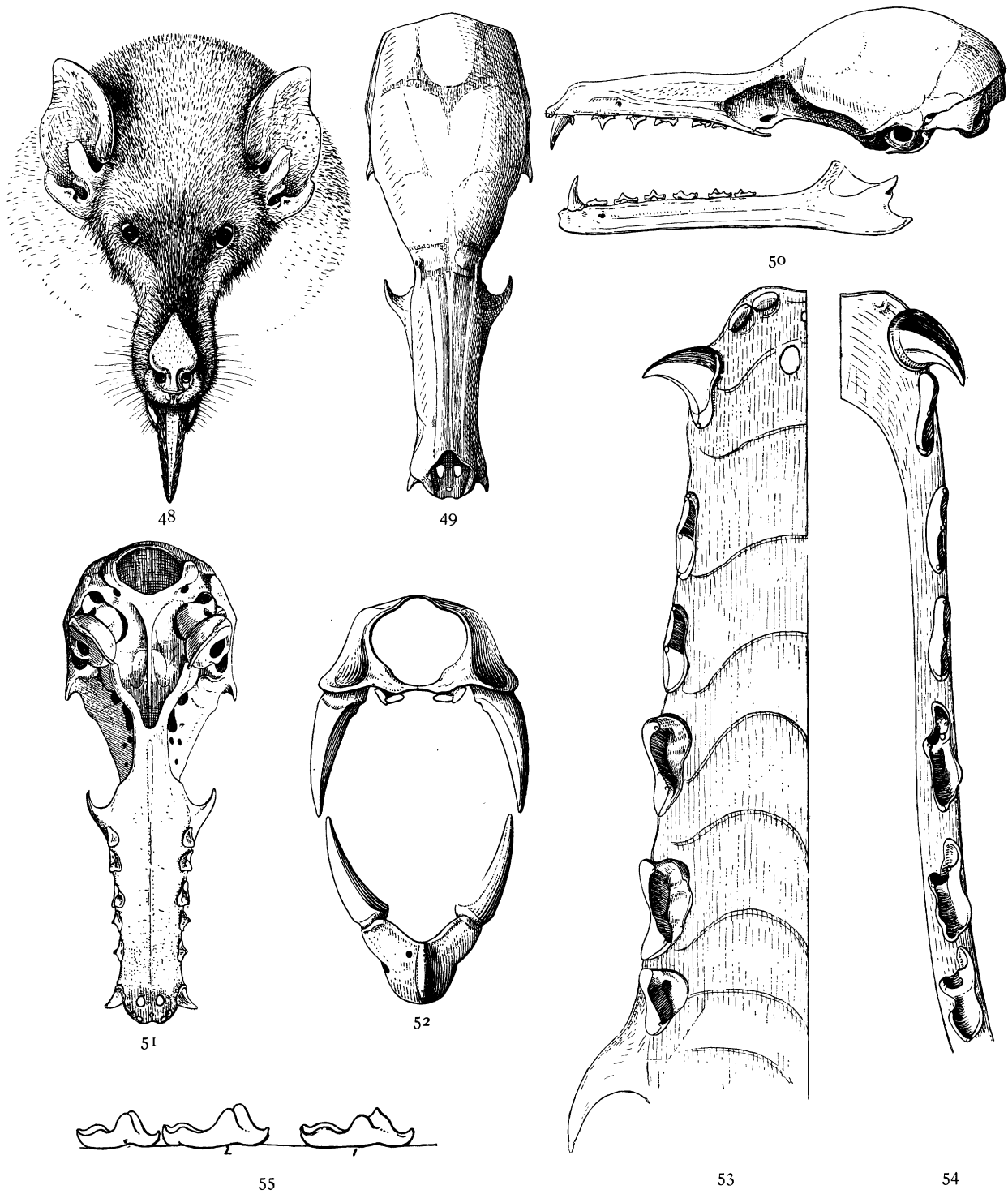
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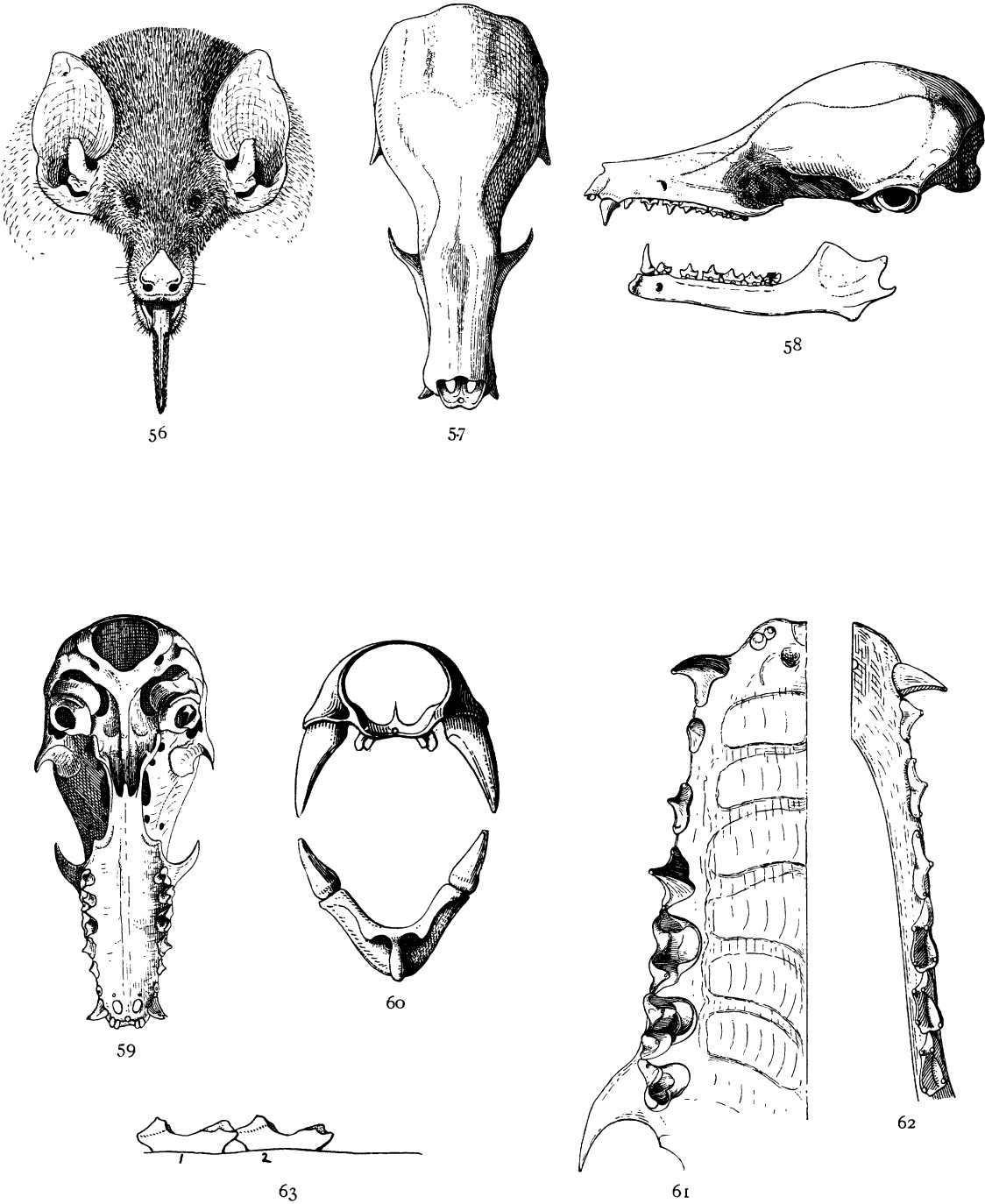
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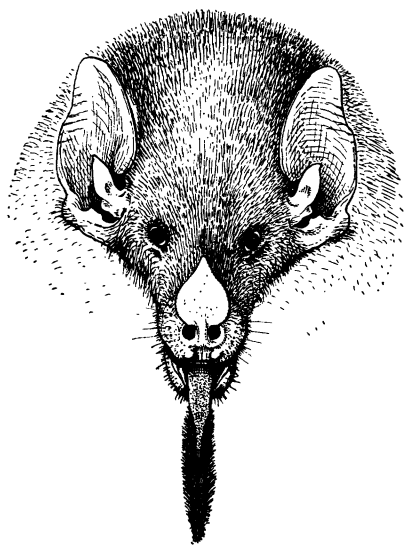
LEPTONYCTERIS NIVALIS.



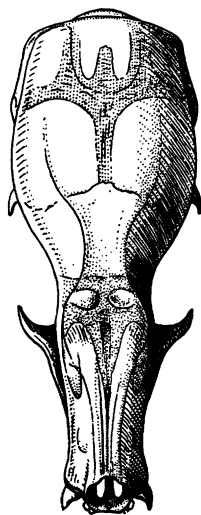
CHŒRNYCTERIS MEXICANA.



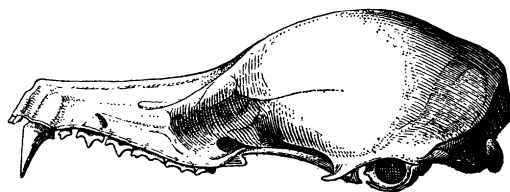
LONCHOGLOSSA CAUDIFERA.



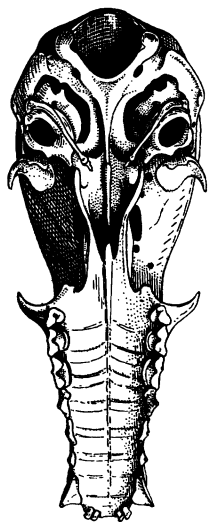
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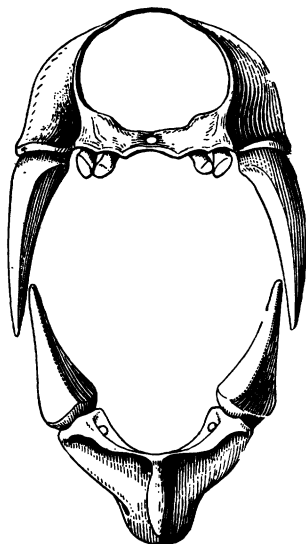
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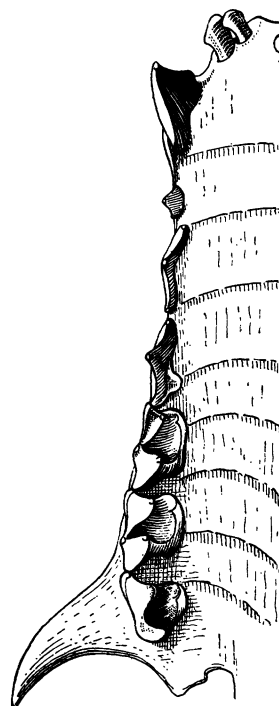
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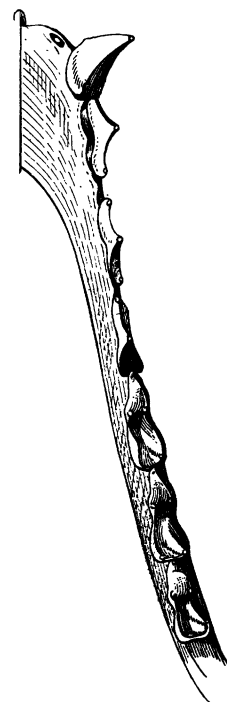
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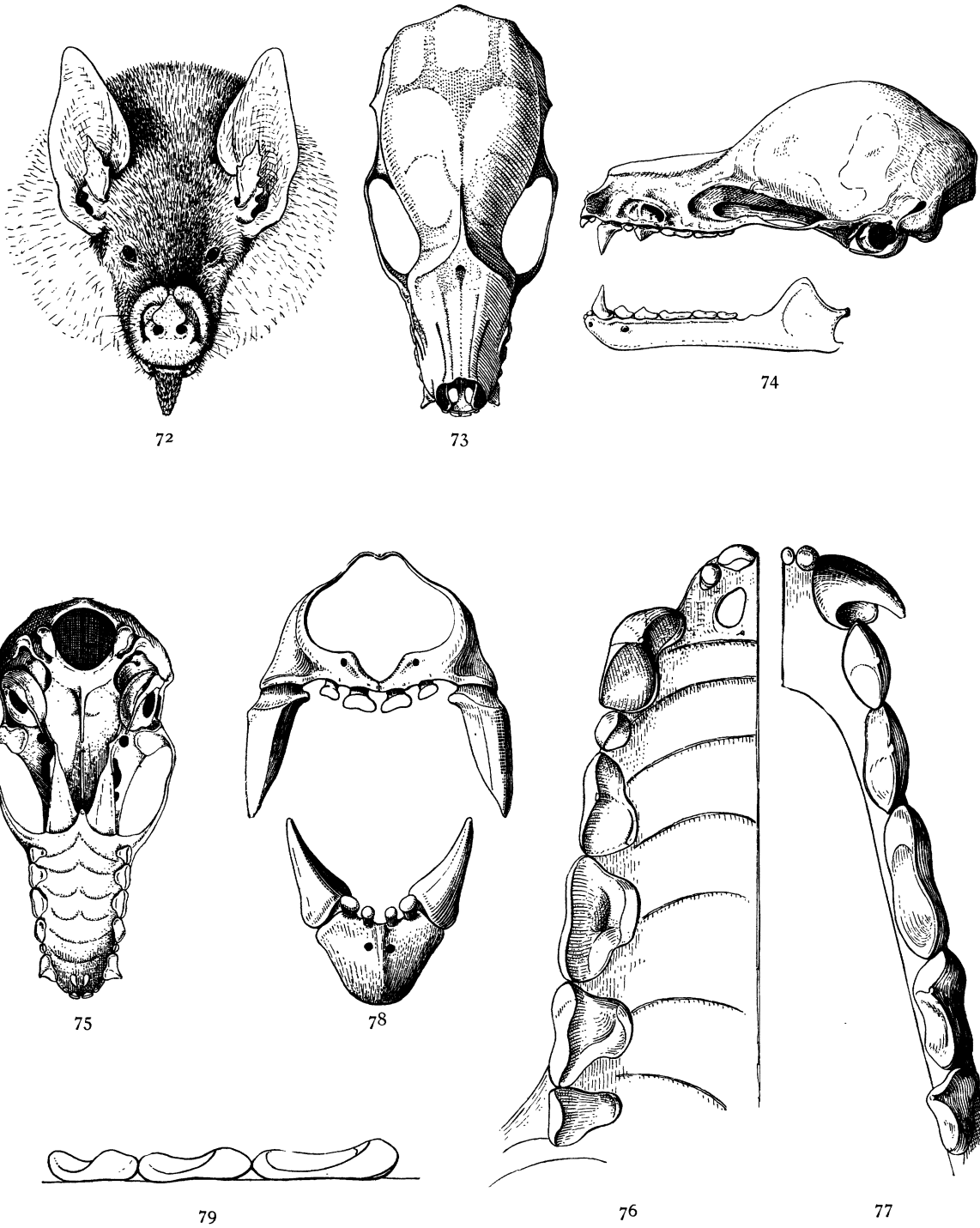


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70

ANURA WIEDII.



PHYLLONYCTERIS SEZECORNI.